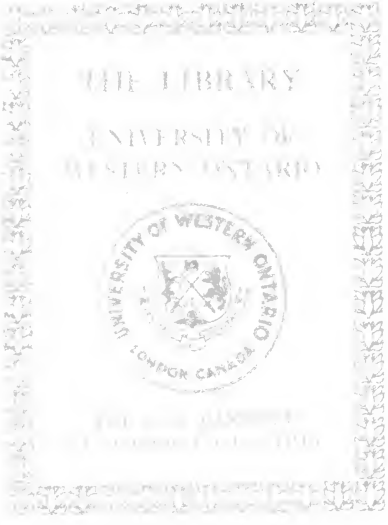

J. Dawes Barnett

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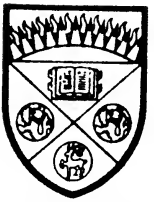

Miller & Co.'s Educational Series.

HINTS AND ANSWERS

TO

EXAMINATION PAPERS

IN

ARITHMETIC.

BY

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EXAMINATION PAPERS.

CHAPTER II.

FUNDAMENTAL RULES, VULGAR AND DECIMAL FRACTIONS, &c.

SIMPLE RULES.

I.—Page 35.

The references indicated by Art. are to the Canadian Edition of Hamblin Smith's Arithmetic.

(1.) Art. 17. (3.) Art. 46. (4.) $3945. (5.) Art. 22. (6.) Art. 24. (7.) $2749. (8.) Art. 31. (9.) 10005100. (10.) 289. Remainder, 34.

II.—Page 36.

(1.) 72. (2.) $1049. (3.) $361593\frac{3}{4}$ hours. (4.) In this question read 83 for 38. 3415956. (5.) 4307. (6.) 3 ft. $7\frac{29}{73}$ inches. (7.) 166 years. (8.) $111. (9.) $80. (10.) 171 cattle—gain $26.

III.—Page 37.

(1.) Art. 46. (2.) Art. 47. (4.) Arts. 43. 41. (5.) 67157148372. (6.) 120 lbs. (7.) 392 miles. (8.) B, $5243; C, $17181; all, $23689. (9.) Art. 50. (10.) 19052.

COMPOUND RULES.

IV.—Page 38.

(1.) 36 of each. (2.) 11 ft. (3.) 10.36767 yds. (4.) $9\frac{5}{99}$.

(5.) 6 women's shares=18 men's shares.
8 children's " =16 women's " =48 men's shares
Hence, 4+18+48=70 men's shares.
And $\frac{2640.70}{70}$=\$37.72½, a man's share.
Then, 3× \$37.72½=\$113.17½, a woman's share.
2× \$113.17½=\$226.35, a child's share.

(6.) 81 ac. 1 r. 32 p. (7.) 424 lbs. 14 dwts. 6½ grs. (8.) 89 $\frac{1}{3}\frac{1}{5}\frac{1}{6}$ qrs. (9.) Income × $\$\frac{2\,1}{1\,2}$=\$ 6250 ∴ Income=\$300000. (10.) A, 60 ac. 3 r. 24 p. B, 89 ac. 3 r. 4⅘ p. C, 99 ac. 1 r. 25$\frac{1}{1}\frac{}{5}$ p. D, 198 ac. 3 r. 10$\frac{2}{1}\frac{}{5}$ p.

V.—Page 39.

(1.) 18662400. (2.) 4 fur. 22 pr. 2 yds. 1 ft. 4 in. (3.) \$1.35 per bushel. (4.) 16s. 3½d. (5.) Art. 42. (6.) \$15213.66. (7.) Art. 20. (8.) $366\frac{5}{2}\frac{3}{1}\frac{9}{5}\frac{4}{4}\frac{}{1}$ (=366¼ nearly.) (9.) \$3327.08. (10.) 271.

VI.—Page 41.

(1.) 67 times; 4 inches. (2.) 1438 acres. (3.) $30303\frac{1}{3}\frac{}{3}$. (4.) \$3187.20. (5.) For 8 oz. read 80 oz. 2⅙ oz.; \$3.90. (6.) £782 2s. 8½d. (7.) 328 times; £5 7s. 6d. remd. (8.) 1 oz. 5 drs. 2 sc. 14⅓ grs. (9.) 258. (10.) \$44387.20.

VII.—Page 42.

(1.) Art. 46. (2.) The required length must be the *greatest common measure* of the three given numbers =9. (3.) Art. 49. The required number of acres must evidently be a *common multiple* of the given numbers.

The least common multiple of the numbers is 3000. The required number of acres is 3000, 600, 9000, &c. (4.) Arts. 53 and 56. (5.) 360. (6.) Art 38. (7.) The numbers, when resolved, are 2^6. 3. 13. 53., 2^6. 3^2. 13. 43., 2^3. 3. 13. 443, and 2^6. 3^2. 13^2 : of which the G. C. M. is 2^3. 3. 13, and the L. C. M. is 2^6. 3^2. 13^2. 43. 53. 443. (8.) The prime factors of 1680 are 2^4. 3. 5. 7. ; the four numbers are therefore 5, 6, 7 & 8. (9.) A would go *once round the island* in $600 \div 20 = 30$ days, B in $600 \div 30 = 20$ days, C in $600 \div 25 = 24$ days, and D in $600 \div 40 = 15$ days. By finding a *common multiple* of these, we shall have the time in which—after each one had gone several times round the island—all would be together again at the point from which they started. The least common multiple of 30, 20, 24 and 15 is 120 ; hence the travellers would come together in 120 days. (10). 33 in each section—the G. C. M. of 132 and 99.

VIII.—Page 43.

(1.) 1400490. (2.) 80 ounces ; 1 oz. gives $7\frac{63}{80}$ half sovereigns, $\therefore$ 80 gives 623. (3.) 5554 oz. (=G. C. M. of the two quantities.) (5.) They stepped together 4440 times. The man took 8800 steps, the woman 13320, and the boy 17600. (6.) 84 seconds. (7.) The interval will be 62370 seconds. The four points will have moved over the distance 315, 125, 70, 54 respectively. (8.) 9 classes of boys and 8 classes of girls. (9.) 6 rods. (10.) 7113120 days, when the first will have made 81760 revolutions in its orbit ; the second, 31755 ; and the third, 19488.

IX.—Page 45.

(2.) 247. (3.) They will do the same quantity in

27, 28, and 30 days, respectively. (4.) 40 bushels. **(5.)** 34560 rails, 13 ft. long. (6.) Art. 56. (7.) 649195944494. (8.) A goes 9 miles, B, 6, C, $4\frac{1}{2}$ and D, 4. (9.) 1400 rods. (10.) A, 2; B, 3; C, 4.

FRACTIONS.

X.—Page 46.

(1.) Art. 64. (3.) $\frac{11}{20}$. (4.) $\frac{5132227}{6380066}$; $\frac{5120084}{6380066}$; $\frac{5131380}{6380066}$; $\frac{143}{46}$. (5.) $\frac{13}{28}$. (6.) $\frac{4}{5}$. (7.) Art. 72; 1. (8.) 1. (9.) $\frac{29}{150}$; $2\frac{103}{182}$. (10.) 1.

XI.—Page 47.

(2.) $\frac{162889}{720000}$ of £100. (3.) $\frac{144}{175}$; 36025 min. (4.) 3d. 16h. 6m. $22\frac{1}{2}$ sec. (5). $\frac{642}{64}$. (6.) 1520 tons. (7.) £4 8s. $1\frac{3}{4}$d. $\frac{307}{725}$q. (8.) The unit is 24 cwt., of which $2\frac{14}{37}$ cwt. is tin, and $21\frac{23}{37}$ cwt. copper. (9.) The length of the measuring rod is $28\frac{7}{852}$ inches, and is contained $98\frac{230}{329}$ times in 77 yards, which is not so near 99 times as by $\frac{99}{329}$ in defect. The distance, therefore, which approaches nearest to 77 yards is 99 times the length of the measuring rod. (10.) If the error be *in defect*, the apparent length is 502 yards, and $24\frac{1}{2}$ inches over. If the error be *in excess*, the apparent length is 499 yards, and $3\frac{5}{8}$ inches over.

XII.—Page 48.

(1.) $7\frac{13}{16}$. (2.) $\frac{1}{21}$. (3.) $\frac{113389}{788940}$. (4.) $140\frac{1}{3}$ yds.; \$6.31$\frac{1}{2}$. (5.) \$29333.33$\frac{1}{3}$. (6.) $\frac{7}{22}$; $1\frac{128}{3168}$. (7.) Lost \$400. (8.) £27 10s. (9.) 25 men. (10.) $1\frac{3}{7}$.

XIII.—Page 50.

(1.) Art. 71. (2.) $\frac{14}{15}$. (3.) \$6000. (4.) $\frac{113389}{394470}$. (5.) $2800\frac{21}{44}$. (6.) $\frac{45}{121}$ of an hour. (7.) \$53.10. (8.) $\frac{181}{421}$. (9.) 1200; Irish, 480; Scotch, 360; English, 360. (10.) \$9561.31$\frac{3}{7}$.

XIV.—Page 51.

(1.) Art. 88. (3.) Art. 108; 24.$\dot{9}75024\dot{1}$; 500.5. (4.) Art. 99; 2.2939153468. (5.) Art. 100; 2.1; 210. (6.) Art. 110. (7.) 432; .00$\dot{8}57142\dot{8}$. (8.) .0108. (9.) Any finite fraction can only be said to be equal or equivalent to the infinite repeating decimal, as the limit of the value which the decimal can never exceed. It may easily be shown that the more figures of decimal are taken, the larger the decimal becomes, and will continue to approach in actual value to the fraction, but within a difference less than can be assigned by any fraction whatever. (10.) This fraction having the factor 7 in the denominator, is apparently one which will produce a repeating decimal, but when the fraction is reduced to its lowest terms, the denominator consists of factors each equal to 2. Repeating 0; Non-repeating 11.

XV.—Page 52.

(1.) .06614; .02027. (2.) $2\frac{17}{764}$; $4\frac{1}{13}$. (3.) lot \$412.37$\frac{11}{97}$; house \$1187.62$\frac{86}{97}$. (4.) $3\frac{183}{280}$. (5.) 44 bbls. (6.) $5\frac{64}{79}$. (7.) \$20. (8.) $\frac{5}{12}$; $1\frac{3}{5}$. (9.) \$65.48. (10.) $906\frac{1}{4}$ tons.

XVI.—Page 53.

(1.) .975; $\frac{975}{1000}$. (2.) .096. (3.) .0144. (5.) 1s. = $\frac{8}{100}$ £. (6.) 11 oz. 9 dwts. $2\frac{2}{11}$ grs. (7.) 3420 grs. (8.) .8 $\dot{8}5714\dot{1}$; 1.21527. (9.) $\frac{21}{1000}$. (10.) .091782$\dot{4}$07. (11.) 5.037$\frac{40}{47}$ which produces a recurring decimal.

XVII.—Page 54.

(1.) 7910000; .005$\dot{3}$. (2.) \$50. (3.) \$6400. (4.) $181\frac{1}{2}$ miles; 8 h. 35 min. (5.) 2.$\dot{3}\dot{6}$. (6.) $70\frac{15}{32}$ sq. in. (7.) \$9.23$\frac{1}{13}$. (8.) .03. (9.) \$18.74. (10.) \$30. (11.) $\frac{329}{103550}$.

XVIII.—Page 55.

(1.) .007916; .0001099989. (2.) 1199.365234375. (3.) 59.0625. (4.) \$14591.66$\frac{2}{3}$ eldest; \$4166.66$\frac{2}{3}$ two others. (5.) Read 4.190476 instead of 4.1908476. 2 tons 2 cwt. 2 qrs. $11\frac{65}{408}$ lbs. (6.) .65706. (7.) $\frac{1001}{1922}\frac{29}{52}$. (8.) .0117203. (9.) Examined, 150; average, 250. (10.) 61.22.

XIX.—Page 56.

(1.) If the work be denoted by 1. Then A and B do 1 in 20 days, or $\frac{1}{20}$ in 1 day. B does 1 in 50 days, or $\frac{1}{50}$ in 1 day. Hence A does $\frac{1}{20} - \frac{1}{50} = \frac{3}{100}$ in one day, and $1 \div \frac{3}{100} = 33\frac{1}{3}$ days, in which A could finish the the work by himself.

And B does $\frac{1}{50}$ in 1 day, or in 20 days he does $\frac{20}{50}$ or $\frac{2}{5}$ of the work.

A does $\frac{3}{100}$ in 1 day, or in 20 days he does $\frac{3 \times 20}{100}$ or $\frac{3}{5}$ of the work.

(2.) A and B do 1 in 6 days, and $\frac{1}{6}$ in 1 day. B does $\frac{1}{5}$ in $1\frac{1}{2}$ days, and $\frac{2}{15}$ in 1 day. And A does $\frac{1}{6} - \frac{2}{15} = \frac{1}{30}$: and $1 \div \frac{1}{30} = 30$ days, $1 \div \frac{2}{15} = 7\frac{1}{2}$.

That is, A does the work in 30 days, and B in $7\frac{1}{2}$ days.

(3.) A does 1 in 15 days, and $\frac{1}{15}$ in 1 day. B does 1 in 18 days, and $\frac{1}{18}$ in 1 day. Together they do $\frac{11}{30}$ of the work. $\frac{19}{30}$ remains to be done. Here B leaves, A continues for 3 days, and in that time does the $\frac{3}{15}$ of the work. When C begins there remains of work $\frac{19}{30} - \frac{3}{15} = \frac{13}{30}$. Of this A does the $\frac{4}{15}$ in 4 days, and C, therefore, must do the $\frac{5}{30}$ in 4 days, or the whole in 24 days.

(4.) 2 days work of A = 3 days work of C;
and 5 " B = 4 " C.
∴ 8 " A = 12 " C;
and 15 " B = 12 " C.
Hence 8 " A = 15 " B;
and 1 " A = $\frac{15}{8}$ " B.

Therefore 36 days work of A = $\frac{15\times36}{8}$, or $67\frac{1}{2}$ days' work of B, or B will require $11\frac{1}{4}$ weeks to complete what A can perform in 6 weeks.

(5.) Glass A contains 3 parts water + 1 part spirits= 4 parts.

Glass B contains 4 parts water + 3 parts spirits= 7 parts.

$\frac{3}{4}$ of water + $\frac{1}{4}$ of spirit=1,
and $\frac{4}{7}$ of water + $\frac{3}{7}$ of spirit=1.
therefore $1\frac{9}{28}$ of water + $\frac{19}{28}$ of spirit=2.

Or the mixture consists of $1\frac{9}{28}$ of water, and $\frac{19}{28}$ of spirit.

(6.) The capacity of the cistern may be represented by 1. Pipe A fills $\frac{1}{3}$ in 1 hour. Pipe B fills $\frac{1}{4}$ in 1 hour. A and B fills $\frac{7}{12}$ in 1 hour, but C empties the cistern in 1 hour. Hence the quantity poured out being greater than that poured in during the same time, the cistern will become empty in a certain time. At 3 o'clock, when C is opened, the cistern contains $\frac{2}{3}+\frac{1}{4}$, or $\frac{11}{12}$. And in 1 hour, $1-\frac{7}{12}=\frac{5}{12}$ in excess of quantity poured out above that poured in. Hence $\frac{11}{12}\div\frac{5}{12}=\frac{11}{5}=2\frac{1}{5}$ hours. The vessel will be empty in $2\frac{1}{5}$ hours after 3 o'clock, or 12 minutes past 5 o'clock.

(7.) $\frac{1}{12}$ of a day. (8.) 9 d. 20 h. 15 m.

(9.) There are 11 intervals between 1 and 12 strikes. The interval of two strikes of the first clock is $\frac{35}{11}$ sec.,

and of the second $\frac{2}{11}$ sec., and the seventh strike takes place on the completion of the sixth interval. The times are $\frac{210}{11}$ and $\frac{150}{11}$ seconds; their difference is $\frac{60}{11}$ of 1 second, or $\frac{1}{11}$ of 1 minute.

(10.) In conjunction at XII, and at intervals of 1 h. $5\frac{5}{11}$ m. thereafter; in opposition at $32\frac{8}{11}$ past XII, and at intervals of 1 h. $5\frac{5}{11}$ m. thereafter; at right angles at $16\frac{4}{11}$, and at intervals of $32\frac{8}{11}$ m. thereafter; liable to be mistaken $5\frac{5}{143}$ m. past XII, and at intervals of $5\frac{5}{143}$ m. thereafter.

XX.—Page 58.

For the first five questions see Art. 224. (6.) 113.27 litres. (7.) 25.38 kilogrammes. (8.) Art. 224. (9.) 108 kilogrammes. (10.) 762 mm. (11.) $\frac{1}{4}$ gram; 1.4147 mm. (12.) 12732.406 kilo.

XXI.—Page 59.

(1.) $200\frac{907}{960}$; $3\frac{5388813}{7642944}$. (2.) 3 cwt. 16 lbs. $4\frac{18}{36}$ oz. (3.) £4 16s. $10\frac{477}{11150}$ d. (4.) 2 h. 57 m. $58\frac{205}{223}$ sec. (5.) $\frac{7}{24}$; $\frac{2}{45}$. (6.) 3. (7.) $1\frac{41}{55}$ min. past 5. (8.) 45.5008 metres. (9.) 1 lb. 6 oz. (10.) 307 sc. 3 r. 8 p.

XXII.—Page 60.

(1.) 8085. (2.) 80. (3.) 2 cwt. 1 qr. $8\frac{49}{50}$ lbs.; 1 cwt. 2 qr. $9\frac{43}{50}$ lbs. (4.) $5\frac{46}{55}$. (5.) 2.411482. (6.) $\$11\frac{1}{9}$. (7.) $3\frac{1}{2}$ h. (8.) $\frac{225}{306}$. (9.) 64 ft. $4\frac{4}{5}$ in.

(10.) Instead of 57700421, read 72644830039; the other number is 2521777.

XXIII.—Page 62.

(1.) 7. (2.) \$261.2685. (3.) $113\frac{1}{623}$ grs. (4.) \$158.40. (5.) A, $18\frac{1}{2}$ days; B, 22 days. (6.) A, \$160; B, 240. (7.) $\frac{27\frac{1}{2}}{71\frac{1}{2}}$. (8.) £199 19s. $2\frac{1}{1920}$d. (9.) 47 lbs. $15\frac{1}{20}$ oz. (10.) $\$59.69\frac{1}{3}$. (11.) 1st year, \$700; 2nd year, \$756.

CHAPTER III.

PAPERS FOR ENTRANCE

INTO

HIGH SCHOOLS AND COLLEGIATE INSTITUTES.

I.—Autumn, 1873. Page 63.

(1.) $18\frac{3}{4}\frac{0}{6}\frac{9}{2}\frac{2}{1}\frac{3}{}$. (2.) $3000. (3.) Art. 71. $15\frac{5}{7}\frac{0}{6}\frac{9}{4}$. (4.) $2\frac{1}{2}\frac{}{2}$ days. (5.) $2\frac{1}{2}\frac{}{2}$ days. (6.) $\frac{9}{8}\frac{6}{3}\frac{8}{5}\frac{8}{4}\frac{}{2}\frac{}{5}$. (7.) $256960. (8.) 26 ft. $3\frac{5}{6}\frac{1}{5}$ in. (9.) $26.19\frac{1}{1}\frac{}{8}$. (10.) Sum$=5387\frac{67}{1}\frac{}{6}\frac{}{2}$, diff. $=120\frac{1}{1}\frac{1}{6}\frac{5}{2}$.

II.—January, 1874. Page 64.

(1.) £4 14s. $1\frac{2}{6}\frac{6}{7}$d. (2.) $29\frac{3}{1}\frac{9}{2}\frac{}{8}$ bushels. (3.) 146730 minutes; $\frac{6}{2}\frac{7}{4}\frac{}{0}$ of a year. (4.) $2\frac{6}{8}\frac{3}{8}$. (5.) $3000, value of house; $600, value of lot. (6.) $2417\frac{7}{8}\frac{9}{0}\frac{3}{0}\frac{}{0}$ sqr. yds. (8.) $2\frac{1}{2}$. (9). 147 bushels. (10.) $7\frac{1}{5}$ days.

III.—June, 1874. Page 65.

(1.) Instead of forty-eight thousand, read four thousand eight hundred; the divisor will then be 200563. (2.) 22503744 square inches; 3 ac. 3 rd. 25 per. 3 yds. 0 ft. 108 sq. inches. (3.) $153\frac{4}{5}\frac{9}{1}\frac{8}{8}\frac{3}{3}$. (4.) $1\frac{1}{7}$ of $\frac{1}{4}$, smallest; $\frac{1}{3}$ of $2\frac{5}{8}$, greatest. (5.) $1\frac{6}{7}\frac{6}{7}\frac{8}{1}$. (6.) $\frac{2}{7}$. (7.) $40000. (8.) £123 16s. $10\frac{4}{5}$d. (9.) 3. (10.) $7500.

IV.—December, 1874. Page 66.

(1.) $476\frac{579}{1051}$. (2.) 44000 ft. (3.) 4750 qrs.; 26 ac. 2 rd. 30 p. 8 yds. 8 ft. 115 in. (4.) 58 yds. 2 ft. 3 in. (5.) £1 13s. $7\frac{3}{4}$d. (6.) $4\frac{23}{64}$. (7.) $8\frac{16}{21}$ yds. (8.) 81 gals. (9.) 9. (10.) 540.32 yds.; $4786.0352.

V.—June, 1875. Page 67.

(1.) 1. (2.) 800 bbls.; $5.75 (3.) $16200. (4.) 15s. $0\frac{29}{48}$d. (5.) $6\frac{216}{1237}$. (6.) $77\frac{151}{1192}$. (7.) $60000. (8.) Read 32 instead of 23. Divisor is 102. (9.) £51 3s. $1\frac{533}{671}$d. (10.) $144451\frac{132}{1604}$ acres.

VI.—December, 1875. Page 68.

(1.) $100.78. (2.) 600 ac. 2 r. 1 p. (3.) $5\frac{167}{252}$. (4.) Art. 73. (5.) 400 barrels. (6.) 1st, $2000; 2nd, $1500; 3rd, $1200; 4th, $1300. (7.) $\frac{8}{15}$; $\frac{6}{5}$. (8.) $555.01\frac{151}{1249}$. (9.) $420\frac{420}{1374}$ lbs. (10.) $131.55; $56.25.

VII.—June, 1876. Page 69.

(1.) $53.88\frac{1}{3}$. (2.) 8.83002. (3.) 4 hrs. 42 min. $15\frac{5}{13}$ sec. (4.) $25\frac{1349}{13731}$. (5.) $4.80. (6.) $12.80. (7.) $34\frac{2}{3}$ cub. in. (8.) 14 days. (9). $80. (10.) $45.

VIII.—December, 1876. Page 71.

(1.) 23048771 square inches; 18 tons 17 cwt. 3 qrs. 18 lbs. 11 oz. (2.) 5040. (3.) 14789. (4.) $\frac{20}{82}$ of 8.2, greatest; $\frac{1}{9}$ of $9\frac{1}{9}$, least. (5.) $40\frac{10}{11}$ miles. (6.) 2 ft. $9\frac{3}{5}$ in. (7.) 114 yds. (8.) $82\frac{3}{5}$. (9.) $37.2\dot{7}48839\dot{}$; .0625. (10.) $11\frac{1}{4}$ ft.

IX.—Page 72.

(1.) 1; $\frac{1}{2}$. (2.) $16\frac{4}{11}$ minutes past 3. (3.) The distance is 3.7984 miles; the beat of the pendulum measures .795872 of a second. (4.) $.1\dot{4}$; 4.8. (5.) Supply

the word *half* before property; \$36000. (6.) $1318\frac{14}{19}$. (7.) 325. (8.) The one is Troy weight, the other Avoirdupois. The pound of feathers is 2 oz. 11 dwts. 16 grs. heavier than a pound of gold; and an ounce of gold is $42\frac{1}{2}$ grs. heavier than an ounce of feathers. (9.) Read 1872, instead of 1827; 31 years. (10.) Read per *cwt.* instead of per *cent.*; \$2.143.

X.—Page 73.

(1.) 3759. (2.) 3 ac. 2 r. 23 p. 10 yds. 8 ft. 10 in. (3.) Wheat 90 cents; Oats 55 cents. (4.) $\frac{6}{11}$. (5.) 62.206 feet. (6.) 40 acres; \$6. (7.) Art. 56. (8.) \$3.36 per day. (9.) \$3915.96. (10.) 3 ft. 8 in; $18341\frac{4}{175}$ lbs.

XI.—Page 74.

(1.) 5d. a pound.

(2.) *Before the Strike:*

52 weeks' wages at \$6 per week, - -	\$312.00
Savings at the end of year, - - - -	10.40
52 weeks' expenses of living, - - -	\$301.60

After the Strike:

Wages, 52 weeks at \$6.80, - - - - -	\$353.60
Expenses of living, &c., increase 10 cts. in 40 cts., gives an additional increase of \$75.40 to \$301.60, and yearly expenses - - - - - - - - - - -	\$377 00
Instead of saving—in debt to amount of -	\$23.40

(3.) 4 revolutions of the larger wheel are equal to 5 of the smaller, which can be made in running 60 feet. (5.) $99\frac{1}{11}$. (6.) $199\frac{107}{321}$ yards. (7.) .067 is more nearly equal. The first is less by forty-eight one hundred-thou-

sandths; the latter is greater by fifty-two one hundred thousandths. (8.) He gains 5 cents on the pound or \$5 per cwt. (9.) $12\frac{12}{19}$ days. (10.) $8\frac{19}{22}$ months.

XII—Page 75.

(1.) $10\frac{188285}{1202656}$; $\frac{74323}{90945}$. (3.) 3rd June. (4.) 3 cwt. 3 qrs. 18.1 lbs. (5.) $39\frac{1}{2}$ miles; 80 miles. (6.) 4 days. (7.) $\frac{3}{10}$. (8.) 40 francs. (9.) 52 yds. 1 ft. (10.) $51\frac{3}{7}$ minutes. The man would have rowed in still water $4\frac{4}{5}$ miles, in the 1 hr. 12 m.; hence stream flowed $\frac{4}{5}$ miles in that time$=\frac{2}{3}$ miles an hour. Rower's rate *down* the stream would, therefore, be $4\frac{2}{3}$ miles an hour, hence, &c.

XIII.—Page 77.

(1.) \$16.10$\frac{5}{15}$. (2.) $261\frac{27}{65}$ lbs.; \$313.69$\frac{11}{13}$. (3.) $37\frac{1}{2}$ cts. (4.) Read "what must be subtracted from"; $\frac{457}{1008}$. (5.) .0338235. (6.) 63 pupils. (7.) £15 16s. 3d. (8.) 55 lbs. 6 oz. 14 dr. (9.) \$0.32$\frac{87}{459}$. (10.) A, 10; B, 20.

XIV.—Page 78.

(1.) \$4000 average yearly gain in 7 years. (2.) If the second has 1 share, then the first has 3 and the third has 4, and sum of all is 8 shares, and value \$4000; they are \$500, \$1500, and \$2000. (3.) 7 workmen at \$10 a week, 14 at \$6.30 a week, and 77 at \$2.80 week. (4.) 3600. (5.) 45 gallons. (6.) $1\frac{19}{21}$ inches. (7.) .127 lbs. Troy. (8.) 200. (9.) \$159.6875. (10.) $1\frac{3}{4}\frac{3}{7}$ hours.

XV.—Page 79.

(1.) 18. (2.) 197 yds. 6 ft. 54 in. 284 yds. 2 ft. $1\frac{1}{5}$ in. (3.) 371280. (4.) $\frac{84}{43}\frac{16}{683}\frac{9}{9}$. (5.) 216000. (6.) 1411141.2. (7.) 2333. (8.) \$15.38$\frac{6}{13}$. (9) £27 6s. (10.) A gets \$36; B, \$60; C, \$57.60.

XVI.—Page 80.

(1.) $16\frac{2}{3}$ pks. (2.) 92. (3.) 252. (4.) 49896; 17. (5.) \$1500. (6.) 65.367. (7.) 27.05. (8.) $\$34\frac{8}{13}$, loss. (9.) 1 lb. 11 oz. 10 dwt. $20\frac{100}{623}$ grs. (10.) Art. 168; \$82.03.

XVII.—Page 81.

(1.) The greatest weight is 40 grains; the least 175 lbs. Troy, or 144 lbs. Avoirdupois. (2.) 68 weeks $3\frac{1}{2}$ days. (3.) The shorter course is to add $\frac{7}{8}$ of the sum to 13 times the sum, £89 6s. $1\frac{17}{64}$d. (4.) \$100 bequeathed gives \$90 to legatee, or he receives \$90 for \$100, or \$1 for $\frac{90}{100}$, and, therefore, \$1000 for $\frac{90000}{100}$ or $1111\frac{1}{9}$ the sum to be bequeathed. (5.) \$1.50 on \$4 is $\frac{3}{8}$ of whole; $\frac{5}{8}$ is, therefore, lost; whole debt \$802.80. (6.) Meadow and arable land is $\frac{1}{5}+\frac{3}{8}=\frac{23}{40}$; the rest $\frac{17}{40}=1$ ac. 3 r. 26 p.=306 poles; and $\frac{1}{40}=18$ poles $\therefore \frac{8}{40}$ or $\frac{1}{5}=144$ poles, meadow; and $\frac{15}{40}$ or $\frac{3}{8}=270$ poles, arable. (7.) \$2.98. (8.) \$640. (9.) $20\frac{1}{300}$. (10.) The \$3 hat; \$3.28.

XVIII.—Page 83.

(1.) Art. 66. (2.) \$536.32; $16\frac{3}{26}$ cts. per lb. (3.) $\frac{1}{3}$. (3.) 4 yds. 5 ft. 16 sq. in. (5.) $\$497.97\frac{9}{203}$; $\$435.72\frac{84}{203}$; $\$392.63\frac{11}{203}$; $\$293.67\frac{99}{203}$. (6.) $5\frac{2}{3}$ cents. (7.) 668 ac. 13 p. 14 yds. 2 ft. 72 288 in. (8.) 48 lbs. of each. (9.) $\$137.98\frac{2}{5}$. (10.) 14 h. 46 min.

XIX.—Page 84.

(1.) Read 7000 grs. instead of 17000; 42500 grs.; $708\frac{1}{2}$. (2.) \$30.30. (3.) 1000. (4.) \$6187.50. (5.) \$6. (6.) \$815; \$12. (7.) 288. (8.) Read 2 in. instead of 3 in.; 454186 times. (9.) \$24000; \$36000. (10.) 1000 bushels.

XX.—Page 85.

(1.) To buy one acre from each required $60+$85=$145; then No. of acres bought is 53215÷145=367. (1.) Each sack must evidently contain a *common measure* of 66 and 90 bushels. Hence 2, 3, or 6 bushels. (3.) Art, 71. (4.) $2\frac{1}{4}\frac{2}{1}\frac{3}{0}\frac{7}{0}\frac{3}{0}$. (5.) $20\frac{4}{7}$ lbs.; $171\frac{3}{7}$ lbs. (6.) $136\frac{8}{9}$ yds. (7.) $6\frac{1}{2}\frac{9}{8}$ days. (8.) $\frac{7}{8}$ of an hour. (9.) Art. 101. (10.) 1000 acres.

XXI.—Page 86.

(1.) 4 days. (2.) $\frac{1}{2}\frac{5}{3}\frac{1}{2}\frac{1}{9}$. (3.) $19\frac{1}{5}\frac{1}{3}$ cts.; $1104\frac{1}{6}$ yds.; $212.08\frac{1}{3}$. (4.) $206\frac{6}{1}\frac{}{9}$ lbs. (5.) 1 h. 1 min. (6.) 9187. (7.) 4.4115; 16.

XXII.—Page 88.

(1.) 198990 inches. (2.) $3^3\times2^4\times7^2\times11\times13$. (3.) 1619. (4.) 352. (5.) $2\frac{2}{1}\frac{}{1}$ days. (6.) 3 pints. (7.) 1709. (8.) £1 3 s. 4d.; 3s. 4d. (9.) $100000. (10.) 840.

XXIII.—Page 89.

(1.) $125. (2.) 2 m. 4 fur. 14 r. 5 yds. 2 ft. 8 in. (3.) $12000; $16000; $7000. (4.) $\frac{4}{5}\frac{2}{7}\frac{6}{6}\frac{2}{0}\frac{9}{0}$. (5.) 25 seconds; 75 yards. (6.) $\frac{5}{12}$. (7.) 8.65. (9.) £1625 7s. $9\frac{3}{4}$d. (10.) 51.

XXIV.—Page 90.

(1.) The factors of the multipliers are 5, 7, 11, 12. (2.) $30.98. (3.) Man's share, $4; woman's, 2.66\frac{2}{3}$; child's, 1.33\frac{1}{3}$. (4.) 29 yds. (5.) 21.66\frac{2}{3}$. (6.) $\frac{1}{4}\frac{3}{0}$. (7.) Multiply numerator and denominator by L. C. M. of 3, 4, 8, and the fraction becomes $\frac{2}{8}\frac{2}{1}$; 562.1. (8.) Whole cost =$440; and to make a profit of $150 the whole must be sold for 440+150=$590. There was sold $\frac{1}{4}$ of

(34+46)=20 yds., for $(5\frac{1}{2}+1\frac{1}{4})\times 20$=\$135. The remainder, 60 yards, must bring \$455; hence it must bring $455\div 60$=\$$7\frac{7}{12}$ per yard. (9.) 50 cents. (10.) $156\frac{6}{35}$ days.

XXV.—Page 91.

(1.) $\frac{3}{4}$. (2.) 1000. (3.) A's, \$1500; B's, \$4500. (4.) .00000032; .00081; 3. (5.) \$76.495 gain. (6.) \$36.165. (7.) 216. (8.) 15 ft. (9.) A gets 35 cents; B gets 5 cents. (10.) 6 years.

XXVI.—Page 92.

(1.) \$337680. (2.) Cistern filled at rate of $325\times 2-100=550$ gals. per hour; number of hours in which it would be filled=$15000\div 550=27\frac{3}{11}$ hours. (3.) The G. C. M. of the numbers, which is 25 yards. (4.) The quantity purchased by the first is $\frac{1}{21}$ greater than that purchased by the second. (5.) $8\frac{4}{21}$. (6.) $11\frac{1}{40}$. (7.) $123\frac{23}{24}$ sq. ft. (8.) Gains \$7.50. (9.) \$2000. (10.) 45.

XXVII.—Page 94.

(2.) 60 cwt. gunpowder, 9 cwt. charcoal, 6 cwt. sulphur. (3.) .056875. (4.) 24000. (5.) 210. (6.) $\frac{10}{13}$; .00000292035. (7.) $47\frac{17}{20}$. (8.) $1\frac{13}{30}$; $\frac{5}{27}\frac{34}{09}\frac{67}{54}$. (9.) \$2256.964. (10.) 3 days.

XXVIII.—Page 95.

(1.) \$1675. (2.) The required number of rods must be a *common multiple* of the three given numbers. The least number of rods is 252. (3.) 2 f. 23 p. 4 yd. 2 ft. 4 in. (4.) \$376. (5.) First, one half-penny is the gain on three half-pence; the gain is, therefore, $\frac{1}{3}$ of capital, and gain in £100 is £$33\frac{1}{3}$, or $33\frac{1}{3}$ per cent. Secondly, one-half-penny is the gain on four half-pence; the gain is

$\frac{1}{4}$ of the capital, and the gain on £100 is £25, or 25 per cent. The difference is $8\frac{1}{3}$ per cent. (6.) Art. 67. 638, 684, 667. (7.) 15. (8.) $.0137507\frac{29}{49}$. (9.) 0. (10.) $13\frac{1}{3}$ days.

XXIX.—Page 96.

(1.) £14 16s. $5\frac{331}{1920}$d. (2.) 120 days; the clock that loses $3\frac{1}{2}$ sec. in 12 hours will show 14 minutes to 2 o'clock, and the other 16 minutes past 2. (3.) $\frac{34}{725}$. (4.) .C0054. (5.) $633\frac{3}{5}$. (6.) A, in the ratio of 25:24. (7.) $\frac{3}{4}$. (8.) $4.05. (9.) 12300; $2\frac{11}{25}$. (10.) A, $5400; B $4600. (11.) $33\frac{1}{3}$ cents on the dollar.

XXX.—Page 97.

(1.) $\frac{43907}{1}$. (2.) $6788571\frac{1}{7}$ gals. (3.) £6 15s. $1\frac{43}{125}$d. (4.) 16000000 cub. ft. (5.) $1\frac{8}{9}$. (6.) $13\frac{5}{7}$. (7.) £26 1s. $1\frac{1}{20}$d. (8.) $2479\frac{1}{6}$ cub. ft. (9.) 30 miles. (10.) $6.75.

XXXI.—Page 99.

(2.) $\frac{35}{36}$. (3.) $19\frac{89}{125}$ cts. (4.) $54.35\frac{1}{3}$. (5.) 7.7577518. (6.) A 12 days; B. 16 days. (7.) $416.70. (8.) $.0820\frac{619375}{0}$. (9.) $55\frac{103}{1203}$. (10.) $395.92\frac{1}{2}$.

XXXII.—Page 100

(1.) Art. 225. (2.) 407 rails and 72 lbs. left. (3.) 1.5416. (4.) $\frac{18755}{10879}$. (5.) $430.26\frac{2}{3}$. (6.) 400. (7.) $868\frac{1}{18}$. (8.) $127\frac{5}{7}$ perches. (9.) 14 gals. (10.) 13s. $9\frac{19}{20}$d.

XXXIII.—Page 101.

(1.) $3\frac{419}{700}$. (2.) $19554.17\frac{1}{7}$. (3.) A gets $30.40; B $18.66\frac{2}{3}$; C $14.93\frac{1}{3}$. It will be found that $\frac{7}{8}$ of the work is done when B and C leave; therefore, $\frac{7}{8}$ of $56 is to be divided in the ratio of $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{15}$; and A gets remaining $\frac{1}{8}$ of the money in addition. (4.) $1.609\frac{1}{7}$ kilos.

(5.) $720.51. (6.) $1800. B's savings are seen to be $1100, or $550 for a year; annual expenditures are, income—300, and income—550, and one of these is $\frac{5}{6}$ of the other, ∴ &c. (7.) $1584. It will be seen that the average per cubic yard is 15 cents. (8.) 500. (9.) 420 miles. (10.) 100.

XXXIV.—Page 102.

(1.) 346. (2. $\frac{11}{32}$. (3.) Taking 4 for numerator the fractions are $\frac{8658}{12654}, \frac{8658}{9139}, \frac{8658}{6327}, \frac{8658}{4446}, \frac{8658}{18278}, \frac{8658}{6327}$. (4.) A 12 days; B 18 days; C 36 days. (5.) 25. (6.) $26\frac{13}{132}$ (7.) $292.74 nearly. (8.) 18 miles. (9.) $1583\frac{55575720433}{54248585000}$. (10.) $12\frac{8}{9}$.

XXXV.—Page 104.

(1.) $17\frac{2}{3}$. (2.) $\frac{325}{224}$. (3.) $\frac{32}{35}$ of a day. (4.) $10140. (5.) $66\frac{12}{13}$ cts. (6.) 12 hours. (7.) $2\frac{1}{22}$ days. (8.) A $1260; B. $1120. (9.) Eldest son $2400; second $1600; wife $3200. (10.) $3.22\frac{34}{153}$. (11.) $2.18\frac{2}{5}$.

XXXVI.—Page 105.

(1.) $\frac{1}{8}$. (2.) $14.31\frac{9}{11}$. (3.) 29 of each. (4.) $281\frac{1}{4}$ inches. (5.) 135535656 sq. inches. (5.) 27 miles 3 fur. 36 per. 2 ft. (7.) $\frac{31}{5}$. (8.) $2250, (9.) $145. (10. $1\frac{1}{5}$ hours.

XXXVII.—Page 107.

(1.) $9.33\frac{3}{5}$. (2.) 612304 gals. (3.) 40° $38\frac{5}{7}$′. (4.) $4000.40. (5.) £192937 15s. (6.) When the servant bought at the prices $40, $5, $50, to obey orders he must spend the L. C. M. of $40, $5, $50, which is $200 on oxen, the same amount sheep, and the same on horses, and ∴ he must buy 5 oxen, 40 sheep, and 4 horses. Had he bought at the prices $40, $5, and $60, he would

only have had to spend \$120 on each, and ∴ he would only have had to buy 3 oxen, 24 sheep, and 2 horses; he, therefore, buys two oxen, 16 sheep, and 2 horses more than necessary, and these at the forfeit prices \$2, \$1, and \$4, cost the servant \$28.

(7.) A 10.15 a. m. A has evidently gone 10 miles, and B gains 2 miles an hour on A, and ∴ will overtake A in 5 hours, or at 3.15 p.m., and will have travelled 50 miles. C must, ∴ travel 49 miles or $4\frac{1}{2}$ hours, and ∴ must start 4 hours 5 minutes *before* 3.15 p.m. or at 11.10 a.m. (8.) \$340.40. (9.) $6\frac{1}{4}$ lbs. (10.) 26 ft. $\frac{19}{27}$ inches.

XXXVIII.—Page 108.

(1.) Divisor 25, dividend 541, remainder 16. From the problem the dividend=33 times the remainder+13; but the dividend always=divisor×quotient+remainder, and since quotient is 21, and divisor=rem.+9, ∴ 33 times rem.+13=21×rem.+21×9+rem., from which rem.=16 ∴ divisor=16+9=25, and since quotient=21, the dividend=21×25+16=541.

(2.) Fraction$=\frac{(\frac{1}{4}+4)\ (4-\frac{1}{4})\times 9999\frac{7}{7}\frac{7}{7}\frac{7}{7}-5}{(3\frac{17}{28}+\frac{1}{7})\times 2\frac{1}{8}\times 1000.}$

$=\frac{4\frac{1}{4}\times 3\frac{3}{4}\times(10000-\frac{5}{7777})}{3\frac{3}{4}\times 2\frac{1}{8}\times 1000.}$

$=\frac{2\ (10000-\frac{5}{7777})}{1000.}$

$=20-\frac{1}{7777\,00}$.

$=19+(1-\frac{1}{7777\,00})$.

$=19\frac{7776\,99}{7777\,00}$.

(3.) Read *two* games instead of *ten* games. The three games are the same as if A should lose *one* game, and then A's money diminished by 10 shillings$=\frac{7}{3}$ (B's money+

10 shillings). ∴ A's money=$\frac{7}{3}$ B's money+$\frac{70}{3}$ shillings+10 shillings. But A's money=4 times B's money, ∴ 4 times B's money=$\frac{7}{3}$ times B's money+$\frac{70}{3}$ shillings+10 shillings.

Or $\frac{5}{3}$ B's money=$\frac{100}{3}$ shillings.

Or B's money=20 shillings.

∴ A's money=80 shillings.

(4.) The G. C. M. of 119 and 153 is 17 which is the number in each class, and ∴ there will be 9 classes in the lower form, and 7 in the upper form, or total number of classes is 16.

(5.) $\frac{1}{12}$. (6.) Cost of wine is \$200, and as he clears \$25, he must sell it for \$225. But he sells it for \$2.25 a gal. ∴ he sells 100 gals., but each gal. by using a false measure, contains $3\frac{2}{5}\frac{4}{5}$ quarts ∴ 100 gals.=99 true gals. Hence he keeps one gallon for his own use.

(7.) It is evident that the number of cents is equal to the number of boys×70+16×30; again the number of cents is equal to (No. of boys+34) 20;

∴ No. of boys×70+480=No. of boys×20+680,

or No of boys×70=No. of boys×20+200,

or No. of boys×50=200;

∴ original No. of boys=4. (8.) \$4653.11.

(9.) Let the value of the estate be the *unit;*

then the first son has $\frac{1}{3}+\frac{1}{9}$,

" " second " " $\frac{1}{3}-\frac{1}{9}$,

" " third " " $\frac{2}{3}(\frac{1}{3}+\frac{1}{9})$,

∴ the three sons together have—

$$(\tfrac{1}{3}+\tfrac{1}{9})+(\tfrac{1}{3}-\tfrac{1}{9})+\tfrac{2}{3}(\tfrac{1}{3}+\tfrac{1}{9})=\tfrac{26}{27}$$

∴ $\frac{26}{27}$+\$300=1, value of estate.

∴ $\frac{1}{27}$ = 300,

or value of estate = \$8100.

(10.) \$741.25.

XXXIX.—Page 109.

(1.) 207192591. (4.) No. Multiplier cannot be a concrete number. (5.) $34\frac{43}{162}$. (6.) $\$12.54\frac{1}{2}$. (7.) A, $54\frac{1}{2}$; B, $33\frac{1}{2}$. (8.) $3840. (9.) $3\frac{1}{3}$ days. (10.) 100 gals.

XL.—Page 111.

(1.) 31 per. 14 yds. 7 ft. 91 inches. (2.) Read find *dividend* 944. (3.) $9.20. (4.) $.1159\frac{29}{69}$. (5.) $64\frac{1}{6}$. (6.) $3\frac{1}{5}$ ft. (7.) A, 75; B, 50; C, 25. (8.) $140. (9.) $2880. (10.) $1250.

CHAPTER IV.

THIRD-CLASS PAPERS.

I.—Page 112.

(1.) 701014000120014009. (2.) 8 years 11 months 13 days 19 hours 5 minutes. (3.) G. C. M. = 51. (4.) L. C. M. = $297\frac{1}{2}$. (5.) $21\frac{2}{84}\frac{12}{00}\frac{9}{0}$. (6.) Diff. = 3 r. 9 per. $27\frac{1}{4}$ yds. (7.) 630 acres. (8.) $3\frac{794}{900}$, $3\frac{28}{900}$, $1\frac{12}{27}\frac{7}{00}\frac{17}{00}\frac{1}{0}$. (9.) 6.152625, 15.21065625, 17.8654. (10.) $\$1.21\frac{36}{209}$ cost per C. (11.) \$2794.93 +. (12.) $\$4315\frac{5}{19}$; $195\frac{5}{21}$.

II.—Page 113.

(1.) £15 17s. $6\frac{91}{400}$d.; £621 13s. 7d. (3.) $1\frac{1}{4}$. (4.) \$11056.10. (5.) By the Unitary Method we get $(216 \times 30 \times 7\frac{1}{2} \times 9\frac{1}{2}) \div (25 \times 228 \times 12 \times 4) = 6\frac{3}{4}$ ft. (6.) $4\frac{13}{14}$ yards. (7.) $80\frac{11}{14}$. (8.) \$8.76. (9.) 105 gives 5 com. $5250 \div 21 = 250$. (10.) \$412 $32\frac{1}{2}$.

III.—Page 115.

(1.) $11\frac{1}{9}$. (2.) $\frac{9}{11}$. (3.) $\$293.12\frac{7}{16}$. (4.) A \$1875, B \$2475, C \$3150, D \$3000. (5.) $\$332.03\frac{1}{8}$. (6.) $\$24.32\frac{1}{8}$. (7.) $6\frac{1}{2}\frac{3}{5}$. (8.) 150 gallons. (9.) $\$16.68\frac{4}{7}$. (10.) $\$231.48\frac{4}{27}$.

IV.—Page 116.

(1.) $\frac{25}{196}$. (2.) $\$9\frac{3}{13}$. (3.) $2.4\dot{6}35355427434\dot{}$; $.47100370\dot{}$. (4.) $7880\frac{5}{12}$ ft.

(5.) True discount $42.41.
Bank " $45.20.
difference $2.79.

(6.) 150.46\frac{2}{3}$. (7.) 20000 men. (8.) 275 shares. (9.) $117\frac{11}{17}$, $882\frac{6}{17}$. (10.) 384 shares. (11.) $28350. (12.) $4000.

V.—Page 117.

(1.) £3 17s. $10\frac{1}{2}$d. (2.) $11.80, $17.70. (3.) $\frac{67}{160}$. (4.) 58 cents. (5.) 5.06\frac{1}{4}$. (6.) A's 3\frac{1}{3}$, B's $2, C's $66\frac{2}{3}$ cents. (7.) $310.08. (8.) $1535. (9.) $175.50. (10.) $1\frac{7}{23}$. (11.) 1267.93\frac{1}{3}$.

VI.—Page 118.

(1.) $3\frac{1}{2}$. (2.) 2997 H ; 24003 O
(3.) A child $14.40 ;
A man, $33.00 ;
A woman, $33.60.

(4.) $16800. (5.) 16 ft. 6 in. (6.) $22\frac{1}{2}$ days. (7.) 39.46\frac{1}{8}$. (8.) $60000. (9.) $108. (10.) $58\frac{4}{17}$ %.

VII.—Page 120.

(1.) Expresssion$=\frac{79}{3}\times\frac{2}{69}\times\frac{104}{107}=\frac{16432}{22149}$. (2.) 12 dozen of each ; 2.39\frac{7}{12}$, 4.79\frac{1}{6}$, 9.58\frac{1}{3}$.

(3.) $1\times($240\div$.96775)=$247.998.

(4.) A's share$=\frac{2}{9}+\frac{47}{540}=\frac{167}{540}$; $\frac{373}{540}$=B's and C's, &c. A's share=$16700. (5.) Pres. worth of 600 ($1.30) for 6 mos. at 8%=625, and 625 – 20=605 cash value, ∴ loss $5. (6.) 17s. $9\frac{5}{11}$d. (7.) 300 barrels. (8.) $7.50. (9.) $334\frac{27}{38}$ yds. (10.) 1426.17\frac{2}{3}$.

VIII.—Page 121.

(1.) 5s ; .0853333357$\dot{6}$19047$\dot{}$. (2.) 9.84\frac{5}{6}$, B must pay A. (3.) Amount earned by 1 man, 2 women and 3

children in 5 days = \$20.66⅔. ∴ 124÷20⅔=6 men, 18 children, 12 women. (4.) 40 %. (5.) $3692\frac{4}{13}$. (6.) Work done by A, B, and C respectively will be in proportion of $\frac{1}{16}$, $\frac{1}{16}$, $\frac{1}{16}$, &c. A $26\frac{7}{8}$ days, B $35\frac{5}{6}$, C $28\frac{2}{3}$. (7.) 20 head more at original price would have cost 800+200=\$1000 ∴ 1000÷20=\$50 original cost, &c.; and 2000÷50=40=No. cattle. (8.) \$97.9+. (9.) $\frac{49}{120}$ miles distance, ∴ $1\frac{2}{4}\frac{3}{9}$ yds. (10.) P. W. of credit price=$\frac{50}{53}$ of credit price=cash price ∴ ratio is 50 : 53.

IX.—Page 122.

(1.) 1st expression=$\frac{\frac{10}{2}}{\frac{28}{3}}$ of $\frac{\frac{5}{3}}{12}+\frac{\frac{85}{6}}{15}=\frac{1027}{1008}$.

2nd expression=$\frac{61}{56}$ ∴ $\frac{61}{56}-\frac{1027}{1008}=\frac{71}{1008}$.

(.2) $.025^3$ is a factor of numerator, and $.025^2$ of the denominator, and the expression = 4 × .025 = .1 ; 2.72637. (3.) $\frac{817}{16000}$. (4.) $\frac{23}{20}$ of cost price=$\frac{19}{20}$ of marked price, &c., \$4.60. (5.) 360. See solution 6, page 12, "Ex. papers." (6.) We have altogether 345 ft. of pathway 5 ft. wide and $62\frac{1}{2}\times 345\times 5\div 9=\$119.79+$ (7.) Expenses=\$560 ∴ net profit \$2260, A's gain=$\frac{15}{9}$ of B's=\$1250 ; B's=\$750 ; ∴ \$260 for managing. (8.) $6\frac{1}{4}$ % ; 15 years. (Sols. 4 and 6, page 8, "Ex. papers.") (9.) \$2480. (10.) \$1732.50. (See Sol. 8, page 8, "Ex. papers.")

X.—Page 124.

(1.) $\frac{77}{279}$. (2.) 12 days. (3.) \$3106.521+. (4.) $526\frac{1}{4}$ gulden. (5.) $5\frac{185}{638}$ seconds. (6.) $\$12783.15\frac{187}{193}$ (page 17 "Ex. papers"). (7.) $\$5949.69\frac{63}{73}$. (8.) $4\frac{1}{2}$ per cent. (9.) \$5.49. (10.) 24014490.

XI.—Page 125.

(1.) .025. (2.) He will save $\$80.47\frac{1}{2}$ by purchasing

demand bill. (3.) 3 inches thick. (4.) 1000 lbs. (5.) \$455.57.+ (6.) 131. (7.) 80 %. (8.) 60. (9.) $1043\frac{3}{4}$ yards. (10.) \$750 per ton.

XII.—Page 126.

(1.) A 504, B 252, C 168, D 126. (2.) 8.145 + (3.) \$1349.89 $\frac{9}{19}$. (4.) \$48.45. (5.) $\$1.11\frac{6}{43}$ per lb. (6.) 51 oz; £14 0s. 6d. (7.) $12\frac{15}{22}$. (8.) $\$667.33\frac{1}{3}$; 33 cows, 10 oxen, 13 horses. (9.) Neglecting value of alloy, an ounce of gold is found to be worth $\frac{246}{5\times37}$, and an ounce of copper to be worth $\frac{126}{5\times1792}$; but an oz. Avoir. : oz. Troy : : 175 : 192. We have then required ratio= $\frac{246}{5}\times\frac{5}{37}\times\frac{1792}{126\times192}=\frac{28700}{333}$. (10.) A \$4000, B \$6100, C \$7000.

XIII.—Page 128,

(1.) 9 : 31. (2.) \$5000 stock (see 24, page 33 Examination papers). (3.) \$20. (4.) \$118.08, \$134.40. (5.) \$744. (6.) $3149\frac{9}{16}$. (7.) $6\frac{5}{12}$. (8.) 56 cents a stone. (9.) $\$2333\frac{1}{3}$. (10.) Amount of alloy in 100 sovs. = 1027.058... grs. at 5s. 2d. an oz. Amount of silver = 11297.641... grs. at £3 17s. 9d. £100—the sum of these values = £7.948+.

XIV.—Page 129.

(1.) $\frac{19}{24}$. (2.) .004. (3.) $\frac{1}{35}$ (4.) 1209.50. (5.) \$108. (6.) 96 bushels. (7.) 10 days. (8.) 80 lbs. tea, 10 lbs. coffee. (9.) $62\frac{1}{2}$ cents. (10.) $\frac{6}{7}$.

XV.—Page 130.

(1.) 1.93959183673469387; .0581877+tons. (2.) £65 15s. $9\frac{9}{19}$d. (3.) True worth=£216 14s. $6\frac{134575}{143}$d. Mercantile value=£216 14s. $1\frac{1}{5}$d. (4.) \$3078 stock. (5.) \$50000. (6.) $\$4166\frac{2}{3}$. (7.) 4%, 5%. In railway stock his income is $\frac{1}{30}$ of his stock; in 2nd case income is $\frac{1}{30}\times\frac{3}{5}+\frac{2}{5}\times\frac{1}{50}=\frac{7}{250}$ &c. (8.) 50 cents. (9.) 12 days. (10.) Will lose 8.81 per cent.

XVI.—Page 132.

(1.) $\frac{1}{3}$. (2.) 15s. $10\frac{10}{21}$d. (3.) A \$11.50, B \$5.75, C \$9.20. (4.) A \$500, B \$400, C \$1000. (5.) 15 men, 20 women, 24 children. (6.) $\frac{1}{2}$ mile an hour (see 11, page 26 "Ex. Papers"). (7.) $42\frac{6}{7}\%$. (8.) $6\frac{74}{221}\%$. (9.) 16974.593 cubic feet (10.) 150, 100 at each rate.

XVII.—Page 133.

(1.) $\frac{1}{3}$. (2.) \$90. (3.) \$660. (4.) 462 apples. (5.) $8\frac{4}{5}$ feet. (6.) 1:10. (7.) 10 minutes. (8.) 5 times. (9.) $\frac{43}{108}$. (10.) $3\frac{7}{31}\%$

XVIII.—Page 135.

(1.) $1097.66\frac{7}{16}$. (2.) 1 day 3 hrs. 52 minutes. (3.) 5.0420168. (4.) \$500. (5.) $\frac{1}{120}$ of furlong. (6.) $33\frac{1}{3}\%$. (7.) \$19.512. (8.) \$217.34+. (9.) 188 oz. (10.) \$6.30.

XIX.—Page 136.

(1.) 0. (2.) 2584. (3.) 8.95+shillings. (4.) .3 shillings. (5.) $726\frac{16}{25}\frac{44}{00}\frac{38}{47}$. (6.) \$400. (7.) 4 furlongs 16 p. 4 yds. (8.) \$8; \$16. (9.) $27\frac{169}{1228}\%$. (10.) $23885\frac{5}{7}$ days.

XX.—Page 137.

(1.) $\frac{109}{6096}\frac{109}{08}$; $\frac{27}{24}\frac{17}{79}$. (2.) 130.86+imperial gallons. (3.) $\frac{1}{10}$. (4.) $\frac{94}{100}$ of 6 months' price=\$4.70, ∴that price is \$5, and \$4.80 is 3 months' price; $\$4.80 - .95\frac{5}{13} = \$3.84\frac{8}{13}$=cash price ∴gain%=30. (5.) 180 years, 95%. (6.) 68 yds. 1 ft. 4 in. (7.) $\frac{1}{120}$, $\frac{1}{121}$; stock 96. (8.) \$96.3. (9.) $5\frac{5}{9}\%$ $(=\frac{1}{18})$ *lost* ∴ selling price of 1st =\$18. $31\frac{3}{7}\%$ $(=\frac{1}{35})$ *gained* ∴ selling price=\$35, and total =53 against *cost* \$43 ∴gain%=$23\frac{11}{43}$. (10.) $2\frac{2}{19}$ lbs. lead, $7\frac{21}{437}$ of tin.

XXI.—Page 139.

(1.) $\frac{61}{140}$. (2.) \$205.51$\frac{7}{8}$. (3.) \$4.50, \$3.50. (4.) \$2677.72$\frac{167}{214}$. (5.) $9\frac{1}{16}$ miles. (6.) 9 months. (7.) \$4.20, \$3, \$180. (8.) $\frac{76800}{623}$ grains=1 sov., or 76800 grs.=623 sovs. *i.e.* $13\frac{1}{3}$ lbs.=623 $\therefore$ 40 lbs.=1869; Ans. 40. (9.) 16 bushels. (10.) 15 ft.

XXII.—Page 140.

(1.) 70 gallons. (2.) \$1.20. (3.) \$500, \$750, \$625. (4.) D's \$1200. (5.) \$7400. (6.) 6 hours. (7.) \$34.66$\frac{2}{3}$; \$50. (8.) A \$675, B \$600, C \$500. (9.) No. $\sqrt{2}+\sqrt{3}<\sqrt{10}$. (10.) By the common way of reckoning there is neither gain nor loss. In reality A *gains*, for pres. worth of 100 due 3 months hence + P. W. of 100 due 9 mos. hence is greater than the P. W. of 200 due 6 months hence.

CHAPTER V.

SECOND CLASS AND INTERMEDIATE.

I.—Page 142.

(1.) 16 oz. gives loss of $1\frac{9}{16}$ ∴ 1 gives loss of $\frac{25}{256}$, and $\frac{25}{256}$ of \$73.92=\$$7\frac{7}{32}$. (2.) \$1444.65$\frac{133}{144}$. (3.) Expression $=\frac{75}{14}+\frac{7}{10}+\frac{5}{4}$ = 7.30714285. (4.) A $15\frac{33}{65}$; B $12\frac{60}{79}$; C $21\frac{21}{47}$. (5.) Theoretical. (6.) $\frac{13}{10}-\frac{3}{10}$ of $\frac{13}{10}$ $=\frac{91}{100}$ ∴ loss$=\frac{9}{100}$; 9%. (7.) Pres. worth of credit price=\$$6.19\frac{277}{317}$ ∴ loss on each bbl.=$10\frac{40}{317}$ cents: he will gain \$$253.15\frac{145}{317}$. (8.) \$$7480\frac{10}{73}$. (9.) *Decrease*= 72.9. Increase=96.6. *Net increase*=23.7 from 2500; and 100 gives .968 %. (10.) \$$9466\frac{2}{3}$. (11.) Hyp.=50, and line joining rt. angle with middle pt. of hyp.=half the hyp.=25. (12.) 3×square of breadth=11346.75 ∴ breadth=61.5, length=184.5.

II.—Page 144.

(1.) Theoretical. (2.) Expression $=(\frac{5}{32}+\frac{91}{96}-\frac{29}{48})$ $\div\frac{2}{56}=14$. (3.) $41\frac{3}{7}$ %. (4.) $14\frac{5}{6}$ months. (5.) C does $\frac{13}{120}$ in one day. A \$9.37½; B \$7.50; C \$8.12½. (6.) \$593.70. (7.) 6 oxen, 15 cows, 75 sheep. (8.) \$$39.94\frac{4}{9}$. (9.) \$7500=cost of goods; then 7500 (1.10) (1.20) (1.25) =\$12375. (10.) $16\frac{1}{5}$ acres. (11.) 216 and 162. (12.) 3.1416 (115^2-90^2).

III.—Page 145.

(1.) Theoretical. (2.) $100-89\frac{79}{89}=10\frac{69}{89}$ %. (3.) $900. (4.) $1250. (5.) $\frac{107}{208}$. (6.) 72, 48, 24. (7.) $5141. See "Ex. Papers" — page 47, q. 7. (8.) $29.04. (9.) $6.01\frac{2}{3}$. (10.) A right-angled triangle; line joining middle points is parallel to base, and=half the base, &c., 150.

IV.—Page 146.

(1.) Find G. C. M.; 7 yds. 2 ft. 2 in. (2.) Time lost in 1 yr.=5 h. 48 min. 49.7 sec. Hence 4th year, leap year, gives *gain*=44 min. 41.2 sec. (in four years). And ∴ time gained in 100 yrs.=18 h. 37 min. 10 sec., which lacks 5 h. 22 min. 50 sec. of 1 day; hence time lost in 100 yrs.=5 h. 22 min. 50 sec. in 400 yrs.=21 h. 31 min. 20 sec., which lacks 2 h. 28 min. 40 sec. of 1 day; ∴ time gained in 4000 yrs.=24 h. 46 min. 40 sec.; or in 4000 yrs. there will be 970 leap yrs.; (5 h. 48 min. 49.7 sec.) $\times 4000$=968 d. 23 h. $13\frac{1}{3}$ sec., and 970 d.—968 d. 23 h. $13\frac{1}{3}$ sec.=as before. (3.) 2000. (4.) 1 oz. alloy will be found=$\frac{3}{16}$ guinea, &c.; $2\frac{47}{64}$ guineas. (5.) 2.2360679774; $\frac{\sqrt{5}+1}{\sqrt{5}-1}=\frac{6+2\sqrt{5}}{5-1}$= 2.618033987. (6.) $1320; $1452. (7.) 4744.186. (8.) $777857\frac{14}{7}$ tons. (9.) 75 cents. (10.) $2000 cost of wheat; $3000 do. of barley; $4000 do. of oats. (11.) 272. (12.) 50.

V.—Page 148.

(2.) 1 oz. Troy = 480 grs. 1 oz. Avoir. = $437\frac{1}{2}$ L. C. M. = 84000 grs. (4.) 42, 1042. (6.) $(\frac{81}{80})^n=3$. n(log 81 —log 80)=log 3. *i.e.* n $\{.477121\times 4-(.301030\times 3+1)\}$ = .477121. ∴ $n=88\frac{79}{174}$. (7.) (1) $1400; (2) 7500; (3) 12; (4) $4480. (8.) 1275 bbls. (10.) $78\frac{4}{7}$.

VI.—Page 150.

(1.) 120. (2.) Theoretical. (3.) 15 tons. (5.) 6400 $-213\frac{1}{3}=6186\frac{2}{3}$; P. W. int. on $6186\frac{2}{3}$ for 8 months @ 5 % $=206\frac{2}{9}$; $213\frac{1}{3}-206\frac{2}{9}=\$7\frac{1}{9}$. (6.) 6993.75. (7.) Selling price to gain 20 % $=96$ $\therefore \frac{9}{10}$ of asked price$=96$ &c. $1.06\frac{2}{3}$. (8.) \$11.73+. (9.) A's $\$1714\frac{2}{7}$; B's $2285\frac{5}{7}$. (10.) 250. See Ex. papers in Arith. q. 7, page 17. (11.) $\$13\frac{1}{3}$. (12.) It may be shewn that the triangle B D C (D being intersection of bisectors)$=\frac{1}{5}$ triangle A, B, C, &c. $75\sqrt{3}$.

VII.—Page 151.

(1.) $3\div 91\frac{5}{8}=\frac{24}{733}$ of invest.$=$gross income $\frac{1}{24}$ of this income tax $\therefore \frac{23}{733}$ of $8063=253$ income. (2.) \$48682.40 rec'd. for the apples \$3.25 a bbl. giving $14975\frac{3}{65}$. See "Ex. Papers" page 17, q. 7. (3.) \$6200.64. (4.) They make revolutions in $11\frac{2}{3}$, 10, $10\frac{1}{2}$, $8\frac{1}{3}$ days respectively, L. C. M.$=1050$. (5.) Disct. at 8%—No days of grace—disct.$=\frac{1}{50}$ of note $\therefore \frac{49}{50}=7600=\$7755\frac{5}{49}$. (6.) Disct.$=\frac{1}{25}$ of principal; then (see Can. Ed. H. Smith's Arith.) Int.$=\frac{1}{24}$: for twice time int.$=2\times\frac{1}{24}=\frac{1}{12}$ and disct.$=\frac{1}{13}$ $\therefore \frac{1}{13}\times 125=9\frac{8}{17}$. (7.) Money worth 7 %, stock in B. C. is $114\frac{2}{7}$, &c. 1st income$=\$2000$; new income 1660.06+. (8.) 20 lbs. at 50c., 20 at 70c. (9.) $\frac{30}{7}\sqrt{1138}$. (10.) Difference in favor of circ. exchange$=$ £2 17s. $11\frac{1}{2}$ nearly.

VIII.—Page 153.

(1.) Theoretical. (2.) $=$£.6583$=$13d. 2d. (3.) $945\times 12\times 23\frac{1}{4}\times 2\frac{1}{3}\times 1\frac{5}{6}$ divided by $33\frac{3}{4}\times 2\frac{2}{3}\times 2\frac{5}{8}\times 217\times 11$, $=2$ hrs. per day. (4.) $(1.02)^4-1=.08243216$ $\therefore$ rate % $=8.243216$. (5.) 14400. (6.) $4\frac{6}{73}$; $5\frac{2}{17}$. (7.) $\frac{11}{100}\times\frac{24}{41}\times\frac{800}{1}=\$1.31\frac{24}{44}$. (8.) G. C. M. of $88\frac{29}{36}$ and $119\frac{25}{36}=$G.

C. M. of num'rs divided by G. C. M. of denoms.=$3\frac{3}{36}$ yds. (9.) $\$99\frac{29}{54}$. (10.) 160 times *square* of thickness= 2500 ∴ thickness=$2\frac{1}{2}$; height 10, length 100. (11.) 335.58824 sq. rods=2.4114 ac.

IX.—Page 154.

(1.) Expression = $(\frac{3}{2}+3-\frac{2}{3}-\frac{12}{5})\div 21\frac{3}{5} = \frac{86}{1251}$. (2.) For every unit of No. we get (1.20) $(1.16\frac{2}{3})=1.40$, &c.; 200. (3.) 100 men. (4.) 4 % loss on the whole; 10 cts. a lb. on $\frac{1}{3}=3\frac{1}{3}$ on whole ∴ 4 % $=3\frac{1}{3}$ cts., &c.; $83\frac{1}{3}$ cts. (5.) Multiply both terms by $8+\sqrt{7}$ gives $10+\sqrt{56}=$ 17.483+. (6.) Goods cost C \$360; B \$384; A \$400. (7.) A's stock=$3\frac{1}{2}\times 5+1\frac{3}{4}\times 7=29\frac{3}{4}$; B's=$4\times 5+1\frac{1}{3}\times$ $7=29\frac{1}{3}$, &c.; A's gain 3570; B's 3520. (8.) Creditors lose 35 cents on \$ ∴ $\frac{5}{100}+8000=\frac{7}{20}$; liabilities=$\$26666\frac{2}{3}$. (9.) $\$16.92\frac{4}{13}$. (10.) 300. (11.) P. W. of £1664=1664 $\times 100\div 103\frac{3}{8}$ which will buy $1676-14.10\frac{942}{2481}$ at 96. (12.) $24\times$cube of length=3000, ∴ length 20; breadth 15; thickness 10.

X.—Page 156.

(1.) \$5000; \$8750; \$11250. (2.) $1\frac{1}{4}(6\div 1.07\frac{1}{2})=$ $6\frac{42}{43}$; $(7-1\frac{1}{2})\div .85=6\frac{8}{17}$. (3.) 60 at \$6; 90 at \$5. (4.) Reckoning from Nov. 1st, $100\times 0=0$, $225\times 5=1125$ &c.; $13\frac{2}{70}$ days; Nov. 14th. (5.) \$100 bought \$96; \$500 must bring 540, ∴ 100, \$108 which is gain $12\frac{1}{2}$ %. (6.) $\frac{2 \text{ ft.}}{2\frac{1}{4} \text{ ft.}}\times 4\frac{1}{2}=4$ ∴ cost would be the same. (7.) Cost $= 10000\ (\$2.15 + .3\times\frac{71}{20}\times 1\frac{3}{8}\times 4\frac{4}{9}) = 28375$; returns $= 10000\times\frac{71}{5}\times .30 = \$33750$; ∴ gain = 5375. (8.) 48 men; length of day same in each case. (9.) $9\frac{11}{64}$ shillings. (10.) [a] $5\sqrt{69}$; [b] $73\frac{1}{14}$ inches.

XI.—Page 158.

(1.) $2 \times 6 \times 8 \times 10 \times 14 \times 135$ divided by $3 \times 5 \times 7 \times 9 \times 15 = 64$. (2.) $30\frac{390}{1427}$. See "Ex. Papers," page 25, q. 9. (3.) \$100 invoice value costs \$125, wh. sells at \$112.50 or 10 % loss $\therefore$ 10 % + 2 % = 600; \$5000. (4.) 2000 f. = \$377.35 direct exchange; cir. exchange gives $\frac{100000}{1310} \times \frac{40}{9} \times \frac{109}{100} =$ \$369.80; \$7.55. (5.) Amt. paid on 2nd contract end of the time = \$20520; $\therefore$ 20520—20000 = \$520 at end of the time. (6.) \$14560 = A's; \$12320 = B's. (7.) £4953 12s. (8.) Sell. price of 1st lot = \$700; of 2nd = \$600; 1400—1300 = 100 loss = $7\frac{1}{7}$ %. (9.) \$99000 new stock gives income \$2475; Amt. consols = $97826\frac{2}{3}$, wh. gives income £$2934\frac{18}{23}$; diff. in income = \$$459\frac{18}{23}$. (**10.**) (1.) $6 \times$ *square* of side = 2300; side = 39.15+; length = 58.73. (2.) Area of second field is $5\frac{1}{2}$ times that of 1st $\therefore$ circumferences are as 1 : $\sqrt{5\frac{1}{2}}$, &c.; \$469.04+.

XII.—Page 160.

(1.) $74\frac{2269}{4480}$ %. (2.) £150 15s. (3.) $59\frac{13}{73}$ seconds. See "Ex. papers," page 25, q. 9. (4.) After his 3rd payment he will still owe \$10508.12$\frac{1}{2}$. (5.) End of 2nd yr. his cap. is $\frac{33}{20}$ of original cap.; of this he loses $\frac{2}{5}$, leaving $\frac{99}{100}$ $\therefore$ \$600 = $\frac{1}{100} + \frac{1}{50}$ of original cap., which = 20000. (6.) \$861.84+; See "Ex. Papers," page 31, q. 20. (7.) Allowing no days of grace $\frac{9}{73} \times \frac{3}{50}$ of principal = $38.70\frac{3}{25}$ $\therefore$ principal = \$5221.85$\frac{1}{3}$. (8.) \$415 very nearly. (9.) \$100; $105\frac{1}{4}$ buys \$100 bond. $\therefore$ \$40000 bonds. (**10.**) (1.) Cost of first = 436.36 +; of second \$354.55 +; difference = \$81.81. (2.) $\sqrt{450} = 15\sqrt{2}$.

XIII.—Page 161.

(1.) 1st expression = $(5 - 2) \times$ £1 10s. 6d. 2nd expression = $(2 + 0)$ of £1 5s. 6d.; diff. = £2 0s. 6d. (2.) Reckoning days of grace disc't is for 73 days = $\frac{1}{5}$ year; true

disc't.=$\$24\frac{55}{202}$; int. on this=*gain*=$24\frac{55}{202}$ cents. (3.) $451.20. See "Ex. Papers," page 27, Ex. 13. (4.) $9500; $16200. See "Ex. Papers," page 19, Ex. 13. (5.) $\$1.87\frac{1}{2}$ =B's; $\$1.56\frac{1}{4}$=C's; $2.50=A's. (6.) $2190. See "Ex. Papers," page 14, Ex. 11. (7.) 116 lbs. @ $5\frac{1}{2}$, 136 lbs. @ $7\frac{1}{4}$. (8.) By 1st method he would pay $1610.51; by the 2nd, the same sum. (9.) Buying prices $12\frac{1}{2}$c., 75c.; selling prices 10c., $1.00. (10.) [*a*] $50^2-40^2=900$=diff. of *squares* of segments, into which required point divides dist.=$120\times$diffce. of segs. $\therefore$ diff.=$7\frac{1}{2}$, sum=120: $63\frac{3}{4}$: $56\frac{1}{4}$. [*b*] Sum of sqs. of parallelogram=sum of squares on diagonals &c., 50.

XIV.—Page 164.

(1.) Expression=$£(\frac{4}{5}\times\frac{55}{12})+(\frac{37}{3}\times\frac{95}{100}\times\frac{5}{1})$s.+700d. =£6 16s. 5d. (2.) A $\frac{125}{52}$; B $\frac{115}{52}$; C $\frac{25}{52}$. (3.) 50 acres. (4.) $380 gain on direct exchange. (5.) $1275=semi-annual income. (6.) $22\frac{2}{39}$ %. (7.) P. W.=$29600; then this $\div$ by $\frac{92\frac{1}{2}}{100}$ and $\times$ by $\frac{6}{100}\times\frac{93\frac{1}{3}}{100}$ gives $896 net income. (8.) Ratio 1st 6 mos. = 4:5; do. 2nd 6 mos.=6:5 $\therefore$ = A $60 for 1 month, B do. $\therefore$ profit to be *equally* divided. (10.) Side=$\sqrt{2\times4\times40\times30\frac{1}{4}\times9\times144}$ $=1584\sqrt{5}$.

XV.—Page 165.

(1.) $75\div256000=.00029296875$. (2.) 4s. $7\frac{1}{2}$d. (3.) $(1.05)^3-1.15$ &c., sum $\$4899.67\frac{3}{61}$. (4.) Actual rate =30—18=12 miles; supposed rate = 30+18=48 $\therefore$ $\frac{12}{48}$ of 1 minute=15 seconds. (5.) 2 yds. blue+1 black cost $\$\frac{158}{77}$, then $\$158\div\frac{158}{77}$=77 yds. black; 154 yds. blue; cloth sells for $184 and $184.07—$158=$\frac{11}{10}$ of usual profit which $\therefore$=$23.70 which is gained on $158=15 %. (6.) £3 16s. 6d. (7.) $998.40. (8.) $1\frac{1}{6}$ days. (9.) $\$5\times\frac{629}{632\frac{3}{10}}$=value of gold; $\$5\times\frac{3\frac{3}{10}}{632\frac{3}{10}}$=do. of silver etc.; Ans. $\frac{2}{6}\frac{0}{3}\frac{0}{2}\frac{0}{3}$ oz. (10.) 1.004+; 2 *ac.* 0 *r.* $26\frac{14}{25}$ *p.*

XVI.—Page 167.

(1.) \$1750. (2.) $\frac{5}{6}$ cost, $1\frac{1}{4}$ second selling price; $37\frac{1}{2} \div 1\frac{1}{4} = 30$. (3.) A's \$28; B's \$22.50. (4.) \$35. (5.) $(7-5) \times$ No. lbs. $= 70 + 30$. ∴ 50 lbs. = \$5.60 cost. (6.) $127\frac{1}{2}$ miles. (7.) 25 miles per hour. (8.) 50 : 51. (9.) $\$24.24\frac{1}{4} \div \frac{19}{20} \times \frac{1}{200} = 5100$, of which 5% = \$255. (10.) A lost $\frac{19}{200}$; B $2 \times \frac{28\frac{1}{2}}{100}$, of which each had ∴ $50.25 \div \frac{67}{100} = 75$.

XVII.—Page 169.

(1.) $\frac{1}{1638}$; $\frac{487}{720}$. (2.) $\frac{7}{13}$. (3.) \$3.20 a yard. (4.) \$1.30; 52 cents; $19\frac{1}{2}$ cents. (5.) $35\frac{47}{85}\frac{3}{1}$d. (6.) 16; L. C. M. of 20 and 50 is 100; then $1600 \div 100 = 16$. (7.) 240. (8.) \$2778.30; $10\frac{61}{120}$. (9.) $\$2222\frac{2}{9}$; $\$4444\frac{4}{9}$; $\$3333\frac{1}{3}$; \$10000. (10.) $\$469.33\frac{1}{3}$.

XVIII.—Page 170.

(1.) £2 1s. 3d. (2.) £188 6s. $3\frac{9}{11}$d. (3.) 127.07 ounces. (4.) C will win by $\frac{25}{2\,9\,4}$ of a yard. (5.) \$6.25 a barrel; 8125 lbs. of tea. (6.) $\frac{27\frac{1}{2}}{71\frac{1}{2}}$ (7.) 7 minutes in 6 miles. (8.) $5\frac{5}{9}$ per cent. gain. (9.) In $1\frac{31}{69}$ years. (10.) 60 cents a lb.

XIX.—Page 171.

(1.) $\frac{1}{6}$. (2.) 405 guns; 5 rounds in 8 minutes $= \frac{5}{8}$ round in 1 min. (3.) Lost \$16.80 − \$12.48 = \$4.32, which divided by 24 cts. + 60 cts. $= 5\frac{1}{7}$ days. (4.) £59 6s. $11\frac{1}{4}$d. or \$286.62. (5.) \$5. (6.) $9\frac{1}{4}$ %. (7.) \$547.50; face— $\frac{1}{10} \times \frac{63}{365}$ of face = \$538.05; *i.e.* $\frac{35}{35}\frac{5}{6}\frac{8}{0}\frac{7}{0}$ of face = &c. (8.) 12 per cent. (9.) At first I pay $\frac{1}{20}$ of the whole, afterwards $\frac{1}{25}$ of the whole minus \$8, (int. on \$200) and this $= \frac{2}{3}$ of former interest, &c. (10.) 3000 days = L. C. M. of the given periods.

XX.—Page 173.

(1.) $2.6583\dot{3}$. (2.) $158400 increase. (3.) 58.8 days. (4.) 1 franc=$.181 : 10000 francs=$1810. (5.) 72 ounces of gold, 24 do. silver. (6.) $2400 ; $3900. See "Ex. Papers," page 19, Ex. 13. (7.) 1.57\frac{1}{2}$ per. lb. and 1.33\frac{1}{3}$ do. (8.) 20.39. (9.) 48.45\frac{41}{50}$. (10.) $450 ; $270.

XXI.—Page 174.

(1.) $\frac{2}{3}$; $\frac{6}{7}$. (2.) $\frac{32}{81}$; $\frac{8}{27}$; $\frac{16}{63}$. (3.) £696 11s. 2d. Gain=£82 18s. 5d. (4.) $12\frac{1}{5}$ months. (5.) 1.53\frac{2}{48}\frac{6}{80}\frac{8}{13}\frac{11}{13}$. (6.) .24. (7.) 70 cents a pound. (8.) $431.52. (9.) ($4800 + $14400) in gold. See Solutions, Sec. IV., prob. 13. (10.) 860.

XXII.—Page 176.

(1.) .2375 : observe that $(.0125)^4$ is a factor of the numerator, and $(.0125)^3$ is a factor of the denominator. (2.) .7071065; 7.071065; 42.42639 ; .1414213; $4\frac{2}{3}$. (3.) A $540; B $200; C $300 ; D $180. (4.) 156 yards. (5.) 2\frac{63}{128}$. (6.) 8 minutes. (7.) 18\frac{2}{11}$. For 1 year. (8.) 2\frac{1}{2}$, and $2 per day. See "Ex. Papers," page 23, Ex. 4. (9.) $33350. (10.) 3570. In the question read horses $\frac{1}{10}$ per cent. &c.

XXIII.—Page 177.

(1.) $\frac{2}{7}$. (2.) 8, 10, and 12 months respectively. (3.) $1190.70+. (4.) Difference in annual income=$37. (5.) A 10.10 ; B $9.09 ; C 6.06 ; L. C. M. of given fractions $=\frac{24}{5}$, then time is 10, 9, 6, &c. (6.) $744.12. See Solutions, Sec. V., question 23. (7.) $1997. (8.) 400lbs., 500lbs., $428\frac{4}{7}$lbs. (9.) .4422. (10.) 55 minutes. See "Ex. Papers," pages 26, 27.

XXIV.—Page 179.

(1.) See "Ex. Papers," page 23, q. 4. It is found that 1d. $= \frac{1}{81}\frac{1}{5}$ oz. $= \frac{1}{5}\frac{1}{5}$ grs. $\therefore$ 1 oz. $= 237\frac{1}{11}$ qrs. (2.) The first says he owns $\frac{5}{7}$ and second $\frac{2}{7}$ of entire quantity; the second farmer says he owns $\frac{1}{4}$, his neighbour $\frac{3}{4}$, $\therefore \frac{3}{4}-\frac{5}{7}$ (or $\frac{2}{7}-\frac{1}{4}$) $= \frac{1}{28} = 57\frac{1}{7}$ acres, $\therefore$ total $=$ 1600; $\therefore$ 1100; 500. (3.) .0047 cub. inches. (4.) 2 hrs. 37 min. (5.) £1222222 4s. $5\frac{1}{3}$d; \$23504 5s. $5\frac{2}{3}\frac{5}{9}$d. (6.) 6%; \$720. See Appendix Canadian Edition of Hamblin Smith's Arithmetic. (7.) $10\frac{4}{5}$ hours per day. (8). $1\frac{4}{7}\frac{4}{7}$ days. (9.) \$5375.90. (10.) 15 months.

XXV.—Page 181.

(1). $160 \div 1.04$—150 divide by $150 = \frac{1}{39} = 2\frac{2}{3}\frac{2}{9}\%$. (2.) For 1st half he earns 90c. per day and requires $\frac{5}{9}$ of whole time, and there is $\frac{4}{9}$ of time left, $\therefore \frac{5}{9} \times 90 + \frac{4}{9} \times 110 = 98\frac{8}{9}$; loss is $\therefore 1\frac{1}{9}$ cts. per day or \$1 in 90; also $\frac{4}{9} \times 112\frac{1}{2} = 50$. (3.) $(1.00\frac{1}{4})(3 \times 98 + 105) = 399.975$, which buys 30 five per cents. and 10 six per cents. (4.) 50 per cent. (5.) \$110. (6.) A 16, B $11\frac{3}{7}$, C $26\frac{3}{7}$. (7.) Sum of rates $= 80$ miles an hour, difference of do. $= 20$ $\therefore$ 30, 50 are the rates. (8.) $8000 \times 3 = 24000 =$ whole stock, of which A pays 9000 B 15000, or 1000, and 7000 more than their shares. (9.) $14 \times 2250 - 15 \times 1960 = 2100$, which is geometric mean between 2250 and 1960; ratio $= \frac{1}{7} = 14\frac{2}{7}\%$. (10.) Amount $= \frac{8}{7}\frac{0}{9} \times 4000$.

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(1.) \$98.80. \$100 received for goods gives \$3 com., and on \$97, \$1.94 com. is received, $\therefore$ whole com. $=$ \$4.94; and 100—4.94 $=$ \$95.06 $\therefore$ \$4.49 $\times$ (1901.20 $\div$ 95.06) $=$ &c. (2.) \$7145. See "Examination Papers," page 17, q. 4. (3.) A \$304.41; B \$333.33. (4.) A $8\frac{3}{5}\frac{8}{3}$; B $13\frac{1}{5}$; C $14\frac{2}{3}\frac{8}{1}$. (5.) £44 11s. 5d. (6.) 4 hrs. 17 min;

8 hrs. $34\frac{2}{7}$ min. (7.) \$2.97; \$1.65; \$1.35. (8.) \$8000. (9.) 58 @ 60c.; 58 @ \$1.08; 29 @ 72c.; and 29 @ 96c. (10.) Area $\sqrt{77 \times 44 \times 21 \times 12} = \sqrt{11^2 \times 7^2 \times 4^2 \times 3^2} = 924$; perpendicular $= 28\frac{28}{65}$.

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A $\frac{1}{2}$ sec., B $\frac{3}{4}$, C $\frac{5}{6}$, D $\frac{7}{8}$, E $\frac{9}{10}$, F $\frac{11}{12}$, G $\frac{13}{14}$; L. C. M. of denoms. $= 2^3 . 3 . 5 . 7$; the L. C. M. of the first four of the resulting frs. $= 2^2 . 3^2 . 5^2 . 7^2 \div 2^3 . 3 . 5 . 7 = 52\frac{1}{2}$ sec.; it will be seen that the L. C. M. of any other four of the fractions will be greater than $52\frac{1}{2}$. (2.) He travels 2 miles in 12 minutes; he and the train *approach* at rate of 2 miles in 4 minutes, or 30 miles an hour—train 30—10=20 miles per hour; length of train $30 \times 5280 \times 10 \div 3600 = 440$ ft.; 2nd train 15 miles an hour, length $= \frac{5 \times 5280}{60} = 440$. Now find point where trains meet $= 1\frac{4}{7}$ miles from tunnel; $17\frac{1}{7}$ seconds. (3.) Gold being $111\frac{1}{9}$; $3375 \times 1\frac{1}{9}$ divided by $50000 \times 1.25 =$ 6 cts. cy. (outlay will be found = \$4025). (4.) Row once each way in $22\frac{1}{2}$ min. &c.; stream will be found to carry boat $\frac{1}{3}$ course in 10 min. $\therefore$ 1 : 3. (5.) \$169. Honest gain $= \frac{1}{7}$ per unit, &c. See "Ex. Papers," page 27, q. 13. (6.) In sixth line read mortgagee for mortg agor; P. W. of mortgage $= \$3486.85\frac{65}{1331}$; P. W. of Deb. = \$2047. $27\frac{3}{11}$ $\therefore$ balance $= \$1439.57\frac{1033}{1331}$. (7.) Cost of dry goods $= \$7486.36\frac{4}{11}$; Broker's sell. price of wheat = \$7725 $\therefore$ total com. $\$238.63\frac{7}{11}$; com. = on sales $= 14.04\frac{6}{11} = \frac{2}{11}\%$ (8.) \$3332. (9.) 451×9 divided by $.2 \times 1.25 \times 40 \times 1.1$ $= £369$. (10.) $\frac{44\sqrt{2} - 8}{5} = 10.84+$.

XXVIII.—Page 186.

(1.) \$120. (2.) B's \$80; A's \$60. (3.) $6 \div 3$ times rate of stream $+ 6 \div$ rate do. $= 2\frac{2}{3}$ hrs.; rate of stream

3 miles, crew 6 miles. (4.) For investing the cash rate $= \frac{1}{21}$, pork $\frac{2}{21}$, gains $\frac{1}{21}$ on every $1 of pork; all cash would bring, com. $211\frac{3}{7}$ instead of 280—diff. made up by com. on pork $\therefore 68\frac{4}{7} \div 21 = \$1440$; $3000 cash. (5.) 400 men. (6.) $960. (7.) 5154.63$\frac{89}{97}$. (8.) *Money worth* 6 %. P. W. = $1000, and $2000; equated time = $6\frac{106}{155}$ months, and P. W. of $3100 for this = very nearly 53 cts. *less* than $3000. (9.) $9.60. (10.) Walk being outside plot, dimensions are $81\frac{3}{7}$, $116\frac{4}{7}$.

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(1.) Of the 80 gallons 52 are water, 28 wine, hence 42 w. at first, &c.; 2:3. (2.) $1008 \div (1 + \frac{2}{100} - \frac{6}{500}) = \$1000$. Days of grace. (3.) $(1000 \times 4 - 800 \times 2) \div 200 = 12$ months back. (4.) $4\frac{1}{5}$ miles per hour. (5.) £201.61+. (6.) The selling prices would be 66c., 84c.; then how mixed to get 76c.?—4@60; 5@75. (7.) $26.01 dec. (8.) Through Paris $223214.28; direct 242222.22+; through Amsterdam $281250. (9.) 12 hr. + (120 ÷ 40) + 75 min. = 4 hr. 15 min. time special arrived in London; 120 ÷ (4 hr. 15 min.—1 hr. 51 min) = 50 miles per hr. special between S. Bridge and London; $\frac{34}{60} \times 30 = 17$ distance from Belle River to Windsor, $26 - 17 = 9$ = distance from Stoney Point to Belle River $(\frac{55}{60} \times 40 - 9) \div (60 - 40) = \frac{83}{60}$ hrs. = time of special from London to Stoney Point, $\frac{83}{60} \times 60 = 83$ miles from London to Stoney Point. 120+83+26=229. (10.) $5250.

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(1.) A $780; B 801\frac{1}{4}$; C 426\frac{11}{14}$; D 991\frac{17}{28}$. (2.) 4:3. (3.). One mile to an inch. (4.) 12, 8, 16; 9600 gallons. Similar solids are as the cubes of their like dimensions.

(5.) $914.36. See Solutions, Sec. V. problem 20. (6.) 1. Note that $(x^2+xy+y^2)(x^2-xy+y^2)=x^4+x^2y^2+y^4$. (7.) 23 months. See Solutions, Section II. problem 8. (8.) 4 lbs. sold for 12c., gain 10%, and $1\frac{1}{3}$ taken off leaves $9\frac{2}{15}$c.,=cost of flour for 4 lb. loaf when wheat is $1.10; but when it is $1 a bus. the cost will be $\frac{10}{11}\times 9\frac{2}{15}=8\frac{20}{33}$c.; $8\frac{20}{33}+1\frac{1}{3}=9\frac{31}{33}$, total cost of loaf with 2nd condition: $11-9\frac{31}{33}=1\frac{2}{33}$ = gain on 11 cents. $\therefore$ $100+1\frac{2}{33}\div 11=9\frac{23}{363}$ ans. (9.) Segments are $4\frac{1}{2}$ ft., $7\frac{1}{2}$ ft.; lengths of lines, 5.57+, 3.307, 4.09. (10.) $19\frac{1}{11}$ degrees.

XXXI.—Page 192.

(1.) $3200, $2800. (2.) In the alloy there will be $\frac{5}{3}$ oz. silver worth $\frac{5}{3}\times\frac{1}{15}=\frac{1}{9}$ oz. gold, and there will be $\frac{10}{3}$ oz. gold $\therefore$ $\frac{10}{3}+\frac{1}{9}=\$51.66\frac{2}{3}$, &c., $15 gold per oz., $1 silver per oz. (3.) 120 days, B earns $4 per day. (4.) Article costs $100; is to gain $110 $\therefore$ $\frac{3}{4}$ selling price$\times\frac{1009}{1004}+\frac{1}{4}$ selling price=110, or $\frac{1013}{1004}$ selling price=110, &c. $=\$113\frac{27}{1013}$. (5.) To realize $2000 he must discount note of $\$2105\frac{5}{19}$. $\therefore$ his profit of 20% will be diminished by $\$105\frac{5}{19}$. $\therefore$ $500+$105\frac{5}{19}=$605\frac{5}{19}$ = 20% of amt.; $\therefore$ amount=$3026. (6.) $50000. (7.) Taxes $32. $\therefore$ house assessed at $1600, is worth $2000, and repairs will be $400; $\therefore$ his rent, leaving out repairs, will be $132; if A be the rent due to taxes, it will be $\frac{A}{1.1}+\frac{A}{(1.1)^2}+\frac{A}{(1.1)^3}+\frac{A}{(1.1)^4}+\frac{A}{(1.1)^5}=400$, $A=\frac{400}{(1.1)^5}\frac{(1.1^5\times.1}{=.1}$; $\therefore$ rent will be this result+$132. (8.) 50 gallons. (9.) 50000. $(\frac{51}{50})^3-1=32604-2000$, &c. (10.) 50 stumps. 1st year's produce=22 bushels $\times$ $1=$22; 2nd year's=24, &c., total value of produce=$130—90=$40, cost of stumping; 1 stump costs, 1st year, $1; 2nd, 90 cts.; 3rd, 80 cts; 4th, 70 cts.; 5th, 60 cts. $\therefore$ 5 cost $4, and $\frac{40}{4}\times 5=50$.

XXXII.—Page 194.

(1.) $\frac{3}{11}$; $\frac{3}{110}$; $\frac{1}{36}$; $\frac{1}{1980}$ or .000505. (2.) 9 hr. 58$\frac{1}{2}$ min. (3.) 40 at 80c.; 40 @ 75c.; 44 water. (4.) £2$\frac{92}{119}$ (less). (5.) P. W. $=450 \div (1.06)^6$, do. $=360 \div (1.06)^5$ ∴ required bill $= \left(\frac{45}{(1.06)^6} - \frac{36}{(1.06)^5}\right)(1.06)^7 =$ \$72.50$\frac{2}{5}$. (6.) \$1 of 1st costs 1.09; \$1 of 2nd costs 87$\frac{1}{2}$, diff. $=21\frac{1}{2}$ cts. ∴ amt. of 1st $=$ \$82 ÷ .21$\frac{1}{2}$, purchased by \$415$\frac{21}{43}$; to which add \$22. (7.) 39$\frac{873}{893}$ above cost. (8.) 1$\frac{1}{59}$ after 12; at 12 p.m. (9.) $460 - (150 + \frac{1}{100} \times 150) =$ 308.50 to be paid 1 month after due with interest at 6 % amounting to \$1.54$\frac{1}{4}$. Equivalent for prepayment is made by reducing per-centage of interest. There remains \$310 principal and 310 − (308.50 + 1.54$\frac{1}{4}$) of interest = .04$\frac{1}{4}$ interest which for 1 month $=$ \$.51 per year $=\frac{51}{3100}$ per cent. (10.) .3874259; 2 ch. 95.77 links. (11.) P. + Prt. $=280$; 2 P. + Prt. $=300$ ∴ P. $=20$.

XXXIII.—Page 196.

(1.) 12$\frac{1}{2}$%. (2.) [a] \$1185.92. [b] \$1158.125. (3.) 7$\frac{1}{2}$% \$517$\frac{1}{2}$ = debt should be given. (4.) [a] \$2500; [b] \$20; [c] \$750. (5.) \$30000. (6.) At S. I. none; at C. I. .243216. (7.) 1 franc $=19\frac{37}{48}$c. (8.) \$30.46. (9.) \$1.02. (10.) 72.

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(2.) £960. (3.) See Canadian Edition of Hamblin Smith's Arithmetic, page 179. See also, Appendix. (3.) \$315. (4.) \$13.15. (5.) 2$\frac{11}{17}$ hours. (6.) A recurring decimal. (7.) £200. (8.) "Ex. Papers," page 26. (9.) £6 per cwt. (10.) [a] 30.594 inches. [b] $137254^2 = (13725 \times 10 + 4)^2 = 13725^2 \times 10^2 + 2 \times 4 \times 10 \times 13725 + 16 = 18838660516$.

XXXV.—Page 199.

(1.) Multiplying numr. and denr. of first fraction by 12, and of second by 60, we get $\frac{54-40+61}{90-52+133} - \frac{705-328}{705+328} = \frac{4336}{58881}$. (2.) 164.3904. (3.) $45000 \times \frac{1}{100} =$ amount of G. T. R. stock he would have received, $45000 \times \frac{1}{100} \times \frac{2\frac{1}{2}}{100} = 1237.50$ income therefrom. Again, $45000 \times \frac{3}{92} = 1467.39\frac{3}{23}$ = income from B. stock. $\therefore 1467.39\frac{3}{23} - 1237.50 = \$229.89\frac{3}{23}$ gain. (4.) If sold at a uniform gain of $12\frac{1}{2}\%$, he would have gained $2\frac{1}{2}\%$ less on the 50 yards than he did gain, and $2\frac{1}{2}\%$ more on the 75 yards. $\therefore$ Net gain $= 2\frac{1}{2}\%$ on 25 yards $= \frac{2\frac{1}{2}}{100}$ of $25 = \frac{5}{8}$ yd. $\therefore \frac{5}{8}$ yd. $= \$2.26\frac{9}{16}$; hence 1 yd. $= \$3.62\frac{1}{2}$. (5.) $7\frac{1}{7}$ miles. (6.) 16 days. (7.) $36 - 34.20 = 1.80$ $\therefore \frac{1.80}{36} = \frac{1}{20} =$ 5% discount off. $\therefore 34.20 = 90\%$ or $\frac{34.20}{90} = 1\%$. $\therefore \frac{34.20}{90} \times 100 = 38$, price required. (8.) From first condition we find 12 men and 16 boys will work 1 day for \$29.40; 12 men and 15 boys will work 1 day for \$28.50; $\therefore$ 1 boy for 1 day \$ .90; and 1 man, 1 day $=$ \$1.25. $\therefore \frac{\$165.60}{\$1.25 \times 6 + .90 \times 7} = 12$ days. (9.) 20 ft. long and $10\frac{1}{2}$ ft. high. (10.) By this investment I make 50% on my money. If I invest in the Consols I make 5% per annum, *i. e.* 20% in 4 years; $\therefore$ gain, $50 - 20 = 30\%$.

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(1.) The gain on the good boxes must include 10% of gain on the whole cost, and the 5% of loss on the damaged boxes. $\frac{\$550 \times 10}{11} = \$500 =$ cost; and the gain on the whole is \$50. $\frac{\$500}{6} \times \frac{2}{1} \times \frac{5}{100} = \$8\frac{1}{3} =$ loss on the damaged boxes. Therefore $\$50 + \$8\frac{1}{3} = \$58\frac{1}{3}$; and if $\$58\frac{1}{3}$ is the gain on $\frac{\$500 \times 4}{6}$ the gain % will be \$17.50.

(2.) 70 cents, the selling price, must include the cost price, 10% of gain, and the price of $\frac{1}{3\,2}$ of every lb. Therefore, if the tea is mixed at 70 cts. $\frac{3\,2}{3\,3}\times\frac{1\,0}{1\,1}=61\frac{2}{3}\frac{5}{6}\frac{7}{3}$ cents per lb., it would simply clear cost. And clearing cost at $61\frac{2}{3}\frac{5}{6}\frac{7}{3}$ cts., if sold at 70 cents would meet all the conditions of the question.

$80-61\frac{2}{3}\frac{5}{6}\frac{7}{3}=18\frac{1}{3}\frac{0}{6}\frac{6}{3}$ loss on every lb. of the dear tea.
$61\frac{2}{3}\frac{5}{6}\frac{7}{3}-60=1\frac{2}{3}\frac{5}{6}\frac{7}{3}$ gain on every lb. at 60 cents.
$61\frac{2}{3}\frac{5}{6}\frac{7}{3}-40=21\frac{2}{3}\frac{5}{6}\frac{7}{3}$ gain on every lb. at 40 cents.
∴Total loss on every lb. of dear tea$=18\frac{1}{3}\frac{0}{6}\frac{6}{3}$. Total gain on 2 lbs. of each kind of the cheap tea$=1\frac{2}{3}\frac{5}{6}\frac{7}{3}+21\frac{2}{3}\frac{5}{6}\frac{7}{3}=23\frac{1}{3}\frac{5}{6}\frac{1}{3}$. Therefore 1089 lbs. will be divided in the ratio of $\frac{18\frac{1}{3}\frac{0}{6}\frac{6}{3}}{23\frac{1}{3}\frac{5}{6}\frac{7}{3}}$: 2 ; 850 : 664×2 ; 425 : 664 ; ∴425 : 332 : 332. That is, 425@ 80 cents ; 332@ 60 cents ; 332@ 40 cents.

(3.) $\$\frac{500\times5}{18}$=the amount paid by the men, $\frac{500\times6}{18}$= amount paid by the women ; $\$\frac{500\times7}{18}$=amount paid by the children. Then if we take the number of men as unity, if the number of women were equal to that of the men, the sum paid by them would be $\frac{500\times5}{18}\times\frac{2}{3}$, but it is $\frac{500\times6}{18}$; therefore the number of women $=\frac{500\times6}{18}\times\frac{18\times3}{500\times5\times2}=\frac{9}{5}$ that of the men ; and in like manner the number of children would be $\frac{2\,1}{5}$ that of the men ; ∴ the whole number would be $1+\frac{9}{5}+\frac{2\,1}{5}=\frac{3\,5}{5}=7$ times the number of men. But 120—15=105, went on the party ; ∴ 7 times the number of men=105 ; and the number of men = 15 ; and number of women $\frac{15\times9}{5}=27$. (4.) $\frac{9\,0}{6\,3}$=the tax on each gallon of crude oil ; $\frac{9\,0}{6\,3}\times\frac{6}{5}$ =the tax as it leaves the producer ; $\frac{9\,0}{6\,3}\times\frac{6}{5}\times\frac{5}{4}=$ the tax as it leaves the refiner. $\frac{9\,0}{6\,3}\times\frac{6}{5}\times\frac{5}{4}\times\frac{2\,8}{2\,5}\times\frac{2\,8}{2\,5}$=the tax on one gallon of the crude oil as it reaches the consumer, but it now measures only $\frac{4}{5}$; ∴$\frac{9\,0}{6\,3}\times\frac{6}{5}\times\frac{5}{4}\times\frac{2\,8}{2\,5}\times\frac{2\,8}{2\,5}\times\frac{5}{4}=3.36$ cents. (5.) If \$100 gives \$6, \$1

would give $\$\frac{6}{100}$, and \$105 would give $\$\frac{6\times105}{100}=\$6\frac{3}{10}$, and this is the dividend paid by the stock. Then if the stock is bought at 10% discount, \$90 will give $\frac{3\times21}{10}=\$6\frac{3}{10}$; and \$100 at the same rate will give $\frac{3\times21\times100}{10\times90}=7\%$; but what was bought at \$90 sells for \$100; $\therefore$ \$90 gains \$10 on the sale; and \$100 would gain $11\frac{1}{9}$ at the same rate; $\therefore$the whole gain is $(7+11\frac{1}{9})\%=18\frac{1}{9}\%$. (6.) The lines joining the centres of the circles form an equilateral triangle; and inasmuch as all the angles at the centre of a circle$=360^0$, the equilateral triangle will include $\frac{1}{6}$ of each flower bed, and taken together$=\frac{1}{2}$ of one of the flower beds; $\therefore\frac{1}{2}$ of the area of one of the flower beds subtracted from the area of the triangle will equal the area of the portion between the flower beds. But area of the triangle$=5529.218+$inches; and $\frac{1}{2}$ the area of one of the flower beds (using $\frac{355}{113}$ as the ratio of the circumference to the diameter)$=5014.375$ inches; therefore the area of the portion between the flower beds$=(5529.218+)-5014.375=514.843+$square inches. (7.) $\$\frac{20000\times9}{10}=\$18000$; and \$18000+\$1000=\$19000 capital at the end of the fourth year. $\$\frac{19000\times9}{10}=\$17100$; and \$17100 +\$1000=\$18100 capital at the end of the third year, and so on for the other years=\$15,904.90 at first. (8.) In this question, the mortgage is supposed to be bartered for its value at the end of the fourth year. $\$\frac{2,500.00\times1}{5}=\$500$, the amount paid down; and $(\$1.08)^5\times2000=\$2938.6561536$, value of the mortgage at the end of the fifth year. $\$\frac{2938.6561536\times100}{110}=\$2671.505941$, the value of the mortgage at the end of the fourth year. \$1+ $\$1.1+\$(1.1)^2+\$(1.1)^3=\$4.641$, the amount of one dollar at the end of the fourth year; that is, the amount of one dollar of annual payment. $\therefore\frac{2671.505941}{4.641}=575.6315$. (9.) $60+10+20=90\%$; $\therefore$the profit is $\frac{1}{10}$ of the whole

receipts. But after the fall in the price of the flour, and rise in the price of delivery, $\frac{3}{5}\times\frac{4}{5}=\frac{12}{25}$ cost of flour; $\frac{1}{10}\times\frac{6}{5}=\frac{6}{50}$ the cost of delivery. ∴The whole cost$=\frac{12}{25}+\frac{6}{50}+\frac{10}{50}=\frac{40}{50}=\frac{4}{5}$; but if the profit is the same as before this must$=\frac{9}{10}$ of his receipts; since $\frac{4}{5}=\frac{9}{10}$ of receipts, ∴ the whole of his receipts must be $\frac{40}{45}$ of what they formerly were. $10\times\frac{40}{45}=8\frac{8}{9}$ cents. (10.) (*a*) If \$20 be the discount of \$200, the same sum will be the interest of \$180 for the same time and rate; and at double the rate, and double the time, the interest will be \$80. Then by the ordinary rule for discount, $\frac{200\times80}{260}=\$61\frac{7}{13}$. (*b*) So for half the time and half the rate of interest, $\frac{200\times5}{185}=5\frac{15}{37}$.

XXXVII.—Page 202.

(1.) $\frac{1}{150}$. (2.) The gain is $\frac{64}{63}$ of 25 on 95, *i.e.* $26\frac{878}{1197}\%$. (3.) What is paid for 175 is received for 96; ∴gain % is $82\frac{7}{24}$. (4.) The rate of No. 1 is .9995; of No. 2, 1.009495. Therefore the rate of gain of No. 2 is .009495 minute in 1 minute; hence No. 2 has been gaining $\cdot\frac{56\cdot97}{009495}$ minute. 5 p.m. Tuesday, Ans. (5.) At first as often as there are 18 sheep there are 3 cows; after 3 cows are driven in, as often as 18 sheep there are 4 cows; the increase has been 1 cow for every 18 sheep. 54 sheep. (6.) Deduct discount for 3 days' grace, $\frac{120}{121}$ of $\frac{121}{8}=\frac{120}{8}$; bank discount for 360 days, $\frac{120}{8}-\frac{100}{7}=$ interest on $\frac{100}{7}$ for 1 year. Rate is 5 per cent. (7.) The money must be paid back out of the common funds of the township. $\$_{230000-115000}^{115000}$ of \$920.00 = \$460.42$\frac{2}{19}$. (8.) Tea, 90 cents per lb.; coffee, 40 cents. (9.) Divide in the proportion of 1 to $(1.05)^3$. \$5000 and \$5788.12$\frac{1}{2}$. (10.) Circumferences are $\frac{22}{7}\times44$ inches and $\frac{25}{7}\times44$ inches respectively. 2 miles $4499\frac{11}{21}$ feet.

XXXVIII.—Page 204.

(1.) $\frac{1121\frac{2}{9}}{100}\times 96 = 108\%$, cost price = selling price of goods gained on; then 8 % goods lost on = 4 % goods gained on; goods lost on = $\frac{1}{2}$ goods gained on = $\frac{1}{3}$ whole. (2.) A sold 224; B 276. (3.) $(\frac{20}{100}\times\frac{100}{112}\times 7)+(\frac{504}{500}\times\frac{100}{112}\times 7)+2 = 9.55$ cents = whole cost; $\frac{120}{100}\times 9.55 = 11.9375$ cents = selling price. (4.) £81$\frac{17}{18}$. (5.) $\frac{15}{15}\frac{12}{12}\times\frac{1.20}{6004.80} = \frac{18}{2116.80} = \frac{6}{7}$ gallon = size of his gallon. (6.) $(\frac{100}{12}-\frac{1000}{132}) = \frac{100}{132}\times$ professors = 50; $\frac{132}{100}\times 50 = 66$ = number of professors. (7.) $\$100\times\frac{16}{9} = 177\frac{7}{9}$ = price of stock, not considering dividend; $\$4\times\frac{400}{409} = \$3.912$ = present worth of \$4 of dividend, to which buyer is not entitled; $\$177\frac{7}{9}+\$3.912 = 181.689$ = price of stock three months before dividend is due. (8.) 18.257 feet. (9.) $10\frac{2}{3}\%$. (10.) (*a*) $6\frac{1}{2}$; (*b*) let p, s, and s′ be perpendicular and segments of base, $30^2-20^2 = s'^2-s^2 = (s'+s)(s'-s) = 35(s'-s)$ $\frac{500}{35} = 14\frac{2}{7} = s'-s$; $35 = s'+s$, from which $s = 10\frac{5}{14}$, $s' = 24\frac{9}{14}$, $p = 17.11$.

XXXIX.—Page 205.

(1.) 7; 75600. (2.) Reduce the decimals to fractions, and divide the numerator by the denominator; the result is $1-\frac{1}{7}+(\frac{1}{7})^2 = \frac{43}{49}\ldots 2.71828\ldots$ (4.) He sells two yards for $(\frac{36}{35}+\frac{36}{37})$ yds.; ∴ the buying price multiplied by $\frac{1296}{1225}\times\frac{120}{100}$ gives the selling price; or the gain divided by $\frac{1296}{1225}\times\frac{120}{100}-1$, gives the buying price; hence we find the cloth cost \$1.00 per yard. (5.) 2400 yards. (6.) \$2048.00. (7.) \$3132.30. (8.) Total commission $\$1.00 = 1-\frac{.98}{1.02} = \frac{2}{51}$; 100 bbls. (9.) ml. f. p. y. in 1 7. 2 0. 1. 1. 7. (10.) $\frac{(6+3)(6-3)\times 30\times .7854}{128} = 4.9701$ cords; 11.597 tons.

XL.—Page 207.

(1.) 10s. 9d. (2.) 24 min. (3.) 29 boys. (4.) $2400. (5.) $576.98\frac{46}{73}$. (6.) $\frac{1}{6}$ consumed, $\frac{5}{6}$ left, of which $\frac{1}{4}$ is spoiled, leaving $\frac{5}{8}$; $\frac{1}{6}$ more is consumed, leaving $\frac{5}{8}-\frac{1}{6}=\frac{11}{24}$; half rations for 110 days consume $\frac{11}{180}\times\frac{1}{2}=\frac{11}{360}$. $\therefore \frac{11}{24}-\frac{11}{360}=\frac{11}{72}$ left=1000 rations for 110 days, $\therefore$ 72000 rations at first; and $720000\div 180=4000$ (men). (7.) A's whole profit $=1675+900=\$2575$. (8.) $(30+10+4)\div(\frac{30}{8.7}+\frac{10}{7.4}+\frac{4}{11.4})=8.65$. (9.) See "Solutions," Sec. III. pr. 13. 35 $\begin{cases} 28\times\frac{115}{100}=32\frac{1}{5} \\ 42\times\frac{120}{100}=50\frac{2}{5} \end{cases}$ $\therefore$ loss of 1 cent on $\frac{5}{14}$ at 28 cents, and gain of 1 cent on $\frac{5}{77}$ at 42; $\frac{5}{14}:\frac{5}{74}=11:2$. (10.) In first case, $11\frac{1}{9}\%=\frac{1}{9}$. $\therefore \frac{8}{9}$ of proceeds=4000; proceeds=4500. In second case, $28\frac{4}{7}\%=\frac{2}{7}$. $\therefore \frac{5}{7}$ of proceeds=5000; proceeds=7000. $\therefore$ whole gain on 9000 is 2500=$27\frac{7}{9}\%$. (**11.**) (1) $\$121\frac{125}{192}$. (2) 927, $772\frac{1}{2}$, 618 (links).

XLI.—Page 209.

(1.) Depends on the principle that the remainder is of same denomination as dividend, 53. (2.) $11.62. (4.) Multiply numerator and denominator of fractions by a number that will make numerators 24, and we get $\frac{24}{316}$, $\frac{24}{354}$, $\frac{24}{297}$, of which last is greatest, and second least. (5.) Quotient is abstract; remainder .00217085 tons, or 4 lbs. 5.4672 oz. (6.) 81 oz. (7.) Difference between $\frac{100}{48}$ and $\frac{100}{60}$ of sum to be distributed=1000. Ans. $2880. (8.) $16000 to A; $31200 to B. (9.) The first way is equivalent to investing at 3% compound interest half-yearly, interest being $1218. As the sum to be advanced on a note of $1000 due 70 (73) days is only $998, the second way is equivalent to investing at such a rate that $998 produces $1000 every 73 days $\therefore$ amount of $1 in 1 year $=(\frac{1000}{998})^5$ or 1.06223. Difference between the two ways

1244.46—1218=26.46. (10.) In question there should be only a comma at "balance," and a period at "lot." B expects to pay at end of 1 year \$75+1 year's interest on \$150; at end of 2 years \$75+1 year's interest on \$75. But he has to pay at end of one year \$75+3 years' interest on \$75; at the end of 2 years \$75+4 years' interest on \$75. Excess at end of 1 year=13.50—9.00=4.50; at end of 2 years=18.00—4.50=13.50. Present loss= $\frac{4.50}{1.08}+\frac{13.50}{(1.08)^2}$ = \$15.74. (11.) Income=400+$\frac{394}{98.5}$=800. At quoted rates \$16 invested gives \$1 annual income; ∴sum must be equivalent to \$10800. Allowing rate of exchange to be that stated, viz. £1=\$4.80. ∴sum required =$\frac{10800}{4.8}$.

XLII.—Page 211.

(1.) 10% gain on half=5% gain on whole. Each of the other transactions gives a loss and a gain of $6\frac{1}{4}$% and $11\frac{1}{4}$% respectively. ∴total gain 10%. Hence \$594 is 10% above cost; ∴ cost price per bushel is \$1.50. (2.) A has 220; B 352; and C 320. (3.) Assume a fourth man, D, to be placed midway between B and C and travelling $4\frac{1}{2}$ miles per hour. D is $12\frac{1}{2}$ miles ahead of A, who gains on him at the rate of $1\frac{1}{2}$ miles per hour. ∴$\frac{12\frac{1}{2}}{1\frac{1}{2}}$= $8\frac{1}{3}$ hours before A overtakes D, and consequently midway between B and C. (4.) Find equivalents at proof for 1000 gals. at 35% and also at 38% above proof, and reduce the difference to 35% above proof; find its value at \$5.40 per gallon, that is $23\frac{19}{27}$ gals. at \$5.40=\$128.00. (5.) Sugar 5 cents per lb.; tea 45 cents per lb. (6.) Stock=\$15600. A's = \$819, B's = \$234, C's = \$351. (7.) \$600. (8.) B's rate = 26 miles per day. (9.) Price of flour per bbl.=\$7.00. Agent's 1st commission $5\frac{1}{10}$% leaves $94\frac{9}{10}$%. Then for every \$104 the agent re-

ceives \$4, ∴ for $94\frac{9}{10}$ he receives $3\frac{1}{2}\frac{3}{0}$; ∴ total commission is $5\frac{1}{10}+3\frac{1}{2}\frac{3}{0}=8\frac{3}{4}$. Hence merchant loses \$912.50. (10.) "The square of two sides of a triangle is equal to twice the square of half the base, together with twice the square of the line joining the vertex and the middle of the base." Line joining vertex and middle of base=17.27 nearly.

XLIII.—Page 213.

(1.) 6 months, 9 months. (2.) \$8. (3.) Cost=\$4.50×70=315; selling price=\$315×$\frac{1}{1}\frac{1}{0}\frac{2}{0}$ ∴ $315\times\frac{1}{1}\frac{1}{0}\frac{2}{0}\div\left(\frac{70\times3\times\frac{1}{2}\frac{9}{0}\times\frac{7}{4}\times3\times\frac{1}{2}\frac{9}{0}}{9}\right)$=\$3.19+. (4.) Solve by similar triangles: 30 Ans. (5.) \$336; \$2016. (6.) $25\div\frac{5}{3}\times2\times\frac{9}{4}$=time second set would take if they worked same number of hours a day; but they work half as long; ∴ their time is $30\times\frac{9}{4}\times2=135$. (7.) $\frac{1}{1}\frac{0}{0}\frac{0}{0}-\frac{1}{7}\frac{4}{}\times3=2\frac{7}{9}\frac{2}{3}\%$. (8.) $\frac{2}{2}\frac{1}{0}\times\frac{2}{2}\frac{1}{0}=\frac{4}{4}\frac{4}{0}\frac{1}{0}$ ∴ $\$27.56\frac{1}{4}\div\frac{4}{4}\frac{4}{0}\frac{1}{0}=\$25$. (9.) Length and breadth are easily found to be 18 ft., 24 ft. Ans. 9 ft. high. (10.) $(5^3-3^3)\times.5236\times\frac{1}{5}\frac{2}{0}\frac{9}{0}=13.2387$ lbs.

XLIV.—Page 214.

(1.) A gets $\$1\frac{1}{4}$; B $\$3\frac{4}{4}\frac{6}{9}$; C $\$6\frac{4}{4}\frac{6}{9}$. (2.) $(\frac{9}{1}\frac{8}{0}\frac{4}{0}\times\frac{1}{1}\frac{0}{0}\frac{0}{1}\frac{0}{1})$ $=\frac{3}{4}\frac{9}{0}\frac{5}{6}$ proceeds flour=amount invested in tea $\frac{11}{406}$; proceeds flour=whole commission=\$220, whence \$8120=proceeds flour, and $\frac{3}{4}\frac{9}{0}\frac{5}{6}\times8120=\$7900$=amount invested in tea. (3.) $\frac{2}{3}\frac{2}{0}=73\frac{1}{3}$ ft.=sum of rates per second; $\frac{2}{1}\frac{2}{5}\frac{0}{}=14\frac{2}{3}$ ft.=difference of rates per second; whence 44 ft. and $29\frac{1}{3}$ ft.=rates per second; or 30 miles and 20 miles per hour. (4.) $(\frac{1}{4}+2\times\frac{1}{3}+3\times\frac{5}{12})$ whole × rate % gained on the $\frac{1}{4}=\frac{2}{1}\frac{6}{2}$ whole × rate % gained on the $\frac{1}{4}=26\%$ whole ∴ $\frac{2}{1}\frac{6}{2}$ rate% gained on the $\frac{1}{4}=26\%$; whence 12%=rate of gain on the $\frac{1}{4}$ ∴ 12%, 24%, 36%, Ans. (5.) $142\frac{2}{9}$ yards. (6.) $1568\frac{3}{5}\frac{2}{1}$. (7.) $37\frac{1}{2}\%$ and \$1.65.

(8.) $\$3357.03\frac{2}{7}\frac{6}{7}\frac{9}{7}$. (9.) The grass on field and 12 weeks' growth will feed 360 oxen for 1 week; or, the grass on field and 8 weeks' growth will feed 320 for 1 week; $\therefore$ 4 weeks' growth will feed 40 for 1 week; $\therefore$ 1 week's growth will feed 10 for 1 week. Or 10 oxen can eat the growth of grass; $\therefore$ 30 oxen can eat the first grass in 8 weeks, or 240 oxen can eat the first grass in 1 week; $\frac{240}{5}=48$ oxen can eat grass in 5 weeks; $48+10=58$ oxen can eat grass and growth in 5 weeks. (10.) \$7600.

XLV.—Page 216.

(1.) \$180. (2.) 9 h. 21 min. A.M. (3.) \$2500. (4.) $1107\frac{7}{8}\frac{7}{9}$. (5.) $9\frac{1}{6}$ miles. (6.) 36 boys, 27 girls. (7.) 5 : 9. (8.) 5 per cent. (9.) Lost $\$\frac{5}{2\,6}$, or $\frac{4}{2\,5}$ per cent. (10.) 1120.

XLVI.—Page 218.

(1.) One side of a square acre is $66\sqrt{10}$ ft. The cost of the four walls, not taking into account the corners, is $\$\frac{4\times66\sqrt{10}\times10\times5\times2\times9}{2\times45\times4}=\$660\sqrt{10}=\$2087.10+$. The price of the four corners is $\$\frac{5\times5\times10\times4\times2\times9}{2\times2\times45\times4}=\$25$. $\$2087.10+25=\$2112.10+$. (2.) $11\frac{1}{9}\%=\frac{1}{9}$, and $9\frac{3}{8}\%=\frac{3}{3\,2}$. A gain of $\frac{1}{4}$ of proceeds is equal to a gain of $\frac{1}{8}$ of cost; hence $\frac{1}{8}+\frac{3}{3\,2}=\frac{7}{3\,2}$ of cost=\$35; cost=$\$\frac{35\times32}{7}=160$; proceeds=\$180. (3.) $43\frac{3}{4}\%=\frac{2\,3}{1\,6}$. His marked price on the second supposition is 10 cents higher than his first selling price, but he throws off 10% of first marked price, and 10% off 5 cents, or $\frac{1}{2}$ cent, and he gains $\frac{1}{4\,0}$ of his outlay less. Hence $\frac{2\,3}{1\,6\,0}$ of cost—$9\frac{1}{2}$ cents $=\frac{1}{4\,0}$ of cost; $\frac{1\,9}{1\,6\,0}$ of cost$=9\frac{1}{2}=\frac{1\,9}{2}$ cents. Cost=80 cents; selling price, \$1.15. (4.) Only \$4040 of first payment will be applied to the stock; the interest on \$4040 for 6 months, and \$2000 for 2 months, is $\$188.26\frac{2}{3}$;

hence the last payment is \$1771.73⅓, and the rate is $\frac{648\times12\times100}{30\times34000}=6\frac{274}{425}\%$. (5.) \$79½. (6.) \$120. (7.) He would have saved \$18 by discounting the note at true discount. (8.) £8$\frac{76}{13}$. (9.) 189 gallons of wine is equal in value to 540 gallons of beer. This is sold so as to gain the price of 94½ gallons of beer. The 72 gallons of beer is sold so as to lose the value of 3⅗ gallons of beer. Hence there is a gain of 90.9 gallons of beer, but the gain is \$27.27. Beer is 30 cents per gallon; wine is 85$\frac{5}{7}$ cents per gal. (10.) $\frac{88\times300}{100\times308}$ of selling price$=\frac{124}{100}$ of cost. Hence selling price$=\frac{124\times100\times308}{100\times88\times300}=1.44\frac{2}{3}$ of cost. 44⅔% Ans.

XLVII.—Page 219.

(1.) Breadth of farm will be found to be 41¼ rods; length 201⅔, of which the G. C. M. is $\frac{55}{12}$, giving 44 lots in length, 9 in width, or 396 each $\frac{55}{12}\times\frac{55}{12}=21\frac{1}{144}$ sq. rods. (2.) See Canadian Edition of Hamblin Smith's Arithmetic. (3.) A makes a revolution in 3½ days; B 3⅔; C 10½; D 3$\frac{1}{7}$—L.C.M.=462, &c. D travels 210 miles more than B. (4.) Int.=$\frac{7}{50}$ of sum; disct.=$\frac{7}{57}$ (see H. Smith's Arithmetic, Can. Ed.) ∴ $\frac{7}{50}-\frac{7}{57}=\frac{49}{2850}=\$98$ ∴ sum=\$5700. (5.) 5 yds. cloth, 10 yds. lining. (6.) Shares of daughter, wife and son are evidently in proportion, 1, 2, 4; ∴ son to $\frac{4}{7}$, wife $\frac{2}{7}$, daughter $\frac{1}{7}$. $\frac{2}{3}-\frac{2}{7}=\frac{8}{21}=\$2400$, &c. If only a son left, dowry=\$2100. (7.) 5 hrs. 32 min. 18$\frac{6}{13}$ sec. (8.) B helped 2$\frac{4}{13}$ days, C 3$\frac{4}{13}$. (9.) \$2.50. (10.) Inc. from Deb.=$\frac{4}{7}$ of sum invested; inc. from B stock=$\frac{2}{21}$ of sum invested: if same sum had been invested in each, income from stock would have been increased $\frac{2}{21}$ of $500=\$47\frac{1}{2}\frac{3}{1}$. ∴ $\frac{2}{21}-\frac{3}{47}=100+47\frac{1}{2}\frac{3}{1}$, &c. \$4700 in Deb., \$4200 of stock (costing \$4000). Stock held \$4.200 $\times\frac{1000}{105}=\$2000$.

XLVIII.—Page 221.

(2.) 10s. $1\frac{107}{253}$d. (3.) $\frac{7}{100}$ of $\frac{1}{2}=\frac{14}{400}$ cap.=profit of first, $\frac{5}{400}$ cap.=profit of second, $\frac{2}{400}$ cap.=profit of third; ∴ profit of first : profit of second : profit of third :: 14 : 5 : 2; whence \$1000=profit of first; \$.357$\frac{1}{7}$=profit of second; \$142$\frac{6}{7}$=profit of third. (4.) 25 %. (5.) Man \$3; woman \$2; child \$1.20. (6.) $\frac{4}{3}\pi\{(21120000+26253)^3-21120000^3\}$ cubic feet$=\frac{4}{3}\pi\{(21120000\times21146253+26253^2)\times26253\}$=number of cubic feet of air. $\frac{14.7}{130}\times\frac{172}{875}\frac{8}{1}\times\frac{4}{3}\pi\{(21120000\times21146253+26253^2)\times26253\}$ = 477008022273777755$\dot{4}$ lbs.=weight of air (7.) A \$12800; B \$19200; C \$24000; D \$28000. (8.) \$257.80. (9.) £1 19s. (10.) Let p be the perpendicular; then $3\times4=2$ area, and $p\times5=2$ area; ∴ $p\times5=3\times4$; $p=2\frac{2}{5}$.

XLIX.—Page 223.

(1.) \$700. (2.) A's gain in 6 months is \$240, or \$1 gains \$$\frac{1}{24}$ per month. B's stock is in trade 12 months; ∴each dollar gains $\frac{12}{24}$; then \$2400÷1$\frac{1}{2}$=\$1600. C's stock gains $640\times\frac{1}{24}$ per month, \$400÷26$\frac{2}{3}$=15 months. (3.) 43.65. (4.) \$1287.87. (5.) 8% of any sum invested in stock at 80 gives the same amount as 10% invested at par. \$13750÷1.10×.08=\$1000. (6.) $6\frac{118}{137}\frac{3}{76}$. (7.) Amount of \$1 paid yearly$=\frac{(1.06)^{41}}{1.06-1}$=4.3746. Amount of \$3000=3000 $(1.06)^4$=3787.4307, 3787.4307÷4.3746=\$865.77. (8.) $18\frac{12}{14}\frac{6}{3}$ minutes past one. (9.) Produce the side of A B to E, making a right-angled triangle A E D. Let x=B C, then $(220)^2+x^2=(880-x)^2$ or $x=412\frac{1}{2}$ yards. Similarly C D=B E=990 yards; then *horizontal* distance from A to D$=\sqrt{(1210)^2+(412\frac{1}{2})^2}$, and

thence distance between *tops* of A and D = $\sqrt{(1210)^2+(412\frac{1}{2})^2+(18\frac{1}{3})^2} = 1278.51$ yards. (10.)
$\sqrt{1260 \div (5 \times 7)} = 6$; 30 rows, 42 trees in a row; 16 acres, 2 rods, 25 poles, $23\frac{3}{4}$ yards.

CHAPTER VI.

FIRST-CLASS CERTIFICATES AND UNIVERSITY HONORS.

I.—Page 225.

(1.) L. C. M. of $\frac{120}{51}$, $\frac{120}{84}$, $\frac{120}{94}$, is $\frac{960}{11}$. (2.) \$6545—\$5928.24=\$616.76. (3.) \$120, and \$36 duty. (4.) $11\frac{66}{877}$, invoice being \$877. (5.) August 1st. (6.) Log. $\frac{1}{2}$=colog. 2=$\bar{1}$.6989700; $\therefore \frac{1}{2}$ log. $\frac{1}{2}=\bar{1}$.8494850; log. $\frac{2}{3}=\bar{1}$.8239087; $\therefore \frac{1}{3}$ log. $\frac{1}{3}=\bar{1}$.9413029—$\frac{1}{4}$ log. $\frac{3}{4}$=0.0312346. Sum of these=$\bar{1}$.8220225. And $-\frac{3}{5}\times\bar{1}.8220225=\frac{1}{5}$ (3—2.4660675)=.1067865. (7.) He gained \$7686.567—\$7633.588=\$52.98. (8.) B has $\frac{1}{32}$ of gain in 1 month, C $\frac{25}{448}$ in 1 month, and \$42000 for 1 month takes $\frac{3}{7}$ of gain, &c. B's \$3062.50; C's \$5468.75. (9.) $40-20\sqrt{2}$ (areas are as squares of like *sides*). (10.) $\frac{1}{4}\times3\frac{1}{7}\times26\times22\frac{2}{5}$ sq. chains=457.41696. (11.) $10^2\times7\times3\frac{1}{7}\div6=256$. (12.) Taking slant height 7, radius of sphere $=\frac{3\sqrt{10}}{5}$; height (perpendicular)=$\sqrt{40}=2\sqrt{10}$. Contents of glass=$3\frac{1}{7}\times(\frac{7}{2})^2\times\sqrt{40}\div\frac{1}{3}$. Solidity of sphere=$3\frac{1}{7}\left(\frac{3\sqrt{10}}{5}\right)^3$.

II.—Page 227.

(1.) $\frac{4}{45}$=G. C. M. of nums.÷by L. C. M. of denoms. (2.) See Canadian Edition Hamblin Smith's Arithmetic. (3.) $75\frac{5}{6}\%$. (1st $91\frac{2}{3}\%$, 2nd $86\frac{2}{3}$, 3rd 80, 4th $66\frac{2}{3}$, 5th 70, 6th 60.) (4.) Labor, \$750; Materials, \$1875.

Take labor for *unit*, then $1\frac{2}{25}+2\frac{3}{4}=\$2872.50$, &c. (5.) $1192\frac{8}{25}$. See "Ex. Papers," page 17, q. 7. (6.) *Gained* $\$1753\frac{11}{13}$; $80\times195+4200$ (cost of new issue)—$120\times179\frac{8}{13}$. (7.) $\$3955\div.98\frac{7}{8}=3994.\dot{9}\dot{4}$. (8.) $\$647\frac{1}{17}$. $36\%=\frac{9}{25}$ duty on $\frac{85}{100}$ of cost=198, &c. (9.) £9 are found=\$43.40 ∴ $3.40\div40\times100=8\frac{1}{2}\%$ premium. (10.) 1 lb. at each price. See rule, Canadian Edition Hamblin Smith's Arithmetic. (11.) $31\frac{7}{24}$, $16\frac{17}{24}$. (12.) Area of second is 10 times that of first. ∴ cost of fencing $=750\sqrt{10}$.

III.—Page 228.

(1.) 720 days. (2.) Month=30 days. Discount on \$100 for $2\frac{1}{10}$ months at 2% a month=$\$4\frac{1}{5}$ ∴ $95\frac{4}{5}$ gives 2 in 1 month, and 100 gives $2\frac{42}{479}$=% per month. (3.) See Canadian Edition Hamblin Smith's Arithmetic. (4.) Mathematically \$6 due in 1 year, \$6 due in 2 years, &c., and \$100 due in 6 years; the sum of these p. ws. (comp. int.) will give the true result=\$82.57+. But if the city be allowed only 6% on its annual payments, an easier formula is had, viz.: $100\times(106)^6\div(1.1)^6=\$80.07+$ (5.) $\bar{3}.544068$. (log. 10—log. 2)+(log. 7—log. 10000). (6.) \$1442.9+. See "Ex. Papers," page 31, q. 20. (7.) Capitals will be in proportion of 52, 45, 36: A, $\$4926\frac{6}{19}$; B, $\$4263\frac{3}{19}$; C, $\$3410\frac{10}{19}$. (8.) 7 % cost + 15 % net gain=22 % ∴ 1 cost realizes 1.22; $1.22\div.94$=amount on which interest must be reckoned. ∴ $\frac{122}{94}\times1.03=1.33\frac{32}{47}$, &c. $33\frac{32}{47}\%$. (9.) Rate per cent.=$\frac{4}{92}\times100$, &c. \$503.70. (10.) $\sqrt{99225}=315$ persons. (11.) $80\times4\times2\frac{1}{4}=\$720$. Perimeter of rectangle=$112\sqrt{10}$, which costs \$796.89+ ∴ difference=\$76.89.+

IV.—Page 230.

Dividends at first 140000; afterwards 840000, &c. 26,000,000. (2.) 1 bushel weight requires $\frac{100}{102}$ mea-

sure; $\therefore \frac{100}{102} \times \frac{5000}{1.06} = \$4624.49$. (3.) Whole cost $= \$133\frac{1}{2}$; $\frac{5}{4}$ of which $= \frac{99}{100} \times \frac{96}{100}$ of selling price, which $\therefore = \$\frac{2781825}{15584}$, $\frac{19}{20} \times 336 =$ No. gallons sold; $\frac{2781825}{15584} \div \frac{1596}{5} =$ 55+cents (4.) Selling price $= 1\frac{1}{5}$ cost, which $\therefore =$ $87\frac{1}{2}$ cents; $\therefore$ on 1 lb at \$1.20, he loses $.32\frac{1}{2}$; on 1 lb @ \$.80 he gains $7\frac{1}{2}$, &c., 3 : 13. (5.) 15 months. (6.) 85 days. (7.) $(1.045)^5 - 1 : 24.8+\%$. (8.) Euclid iii. 35, 6 (2 depth of water+6) $= 40^2$. $\therefore$ depth $= 130\frac{1}{4}$ inches. (9.) Sum of squares of two sides = twice square of half base+2 square line joining vertex and middle point. $5\sqrt{10}$. (10.) $\frac{4}{3}\pi(2^3+3^3) = \frac{140}{3}\pi =$ volume of required sphere; $\frac{140}{3}\pi \div \frac{4}{3}\pi = r^3$. $\therefore r = 3.271066$.

V.—Page 231.

(2.) $\frac{2}{25}$ of $(\frac{6}{5})^3 = 576$, &c. $\$4166\frac{2}{3}$. (3.) .0306; the proposed pointing in effect makes the quantity 10 times less, the multiplier $\therefore$ is $\sqrt{10} = 3.162$—which multiplied into the erroneous result, .009676, gives approximately the true result. (4.) £3 17s. $10\frac{1}{2}$d. $=$ £$3\frac{143}{160}$ (£1 = \$$4\frac{4}{9}$), and contained $\frac{11}{12} \times 480 = 440$ grs. fine gold $\therefore$ \$1 contained $440 \times \frac{160}{623} \times \frac{9}{40} = 25.42+$ grs.; by the new rate \$1 contained $\frac{9}{10} \times 258 \times \frac{1}{10} = 23.22$ grs., and the former is about $9\frac{1}{2}\%$ greater than the latter. (5). Oats 1, barley $1\frac{1}{5}$, wheat $2\frac{3}{4}$; then $1.1+2.97+1.128 =$ \$2599 $\therefore$ \$500 in oats, \$600 barley, \$1375 wheat. (6.) Boy 90 cts., man \$1.60. (7.) "Deduct his commission at $2\frac{1}{2}\%$;" flour sold for $\frac{10870}{23} \times \frac{8000}{459} \times \frac{1}{1200} = \$6.86+$. See "Ex. Papers," page 17, q. 7. (8.) $\frac{81}{16} - 13000 = 4$, &c.; $\$12235\frac{5}{17}$. (9.) $\frac{1}{11} - (\frac{1}{27} + \frac{3}{56}) = \frac{5}{7560} =$ $\$3\frac{588}{189}$, &c. \$5000. See "Ex. Papers," page 33, q. 23. (10.) The 4% being at $88\frac{8}{9}$, money is worth $4\frac{1}{2}\%$; Interest on £6000 for 4 months at $4\frac{1}{4}\% =$ £90; gain $=$ £330 $= 5\frac{1}{2}\%$. (11.) Area of figure formed by radii and tangents $= r^2\sqrt{3}$; area of sector of circle $= \frac{1}{3}\pi r^2$. $\therefore$ area of figure $= r^2(\sqrt{3} - \frac{1}{3}\pi)$.

VI.—Page 233.

(1.) $\frac{4}{5}-\frac{1}{20}\frac{3}{8}=360$ marks $\therefore$ 2400=aggregate, and 1800 minimum for pass. (2.) In first case 460 roubles=£40; in second, £28 $\therefore$ broker gains £11$\frac{1}{4}$. (3.) First is $\frac{1}{3}(4+\sqrt{7})$, second is $1+\sqrt{7}$, &c. (4.) Taking capital for *unit*: $\frac{2}{2}\frac{6}{5}-\frac{2}{2}\frac{5}{5}=\frac{2}{2}\frac{4}{5}$=remainder end of first year; $\frac{2}{2}\frac{6}{5}$ of $\frac{2}{2}\frac{4}{5}-\frac{2}{2}\frac{5}{5}$ end of second year, &c.; $\therefore \frac{(\frac{2}{2}\frac{6}{5})^n-\frac{2}{2}\frac{5}{5}\{(\frac{2}{2}\frac{6}{5})^n-1\}}{\frac{2}{2}\frac{6}{5}-1}=0$; n(log. 26 —log. 25)=log. 2 : n=17.67. (5.) 4$\frac{8}{9}$. (6.) \$81. (7.) $\frac{36-28}{1000}=\frac{1}{125}$ cargo=\$900, &c. Owner loses $\frac{112500}{5}+\frac{4}{5}(112500)\times\frac{41}{100}$=\$26550. (8.) It will be found that 35% of yearly receipts=\$540000, &c. Weekly receipts= \$29670$\frac{30}{91}$. (9.) \$1 of A's stock gains $\$\frac{8}{25}$, of B's $\frac{10}{25}$, of C's $\$\frac{12}{25}$; B's stock was in trade 2 months longer than A's $\therefore \frac{10}{25}-\frac{8}{25}=\frac{2}{25}$ gain in 2 months $\therefore \frac{1}{25}$ in 1 month: A's 8 mos.; B's 10 mos.; C's 12 mos. (10.) $\frac{1200\times7000\times56}{1728}$ =272222$\frac{2}{9}$ sq. inches. (11.) Produce C A to L, making A L=A C; join B L $\therefore$ B L=K D. But in any triangle sum of squares on two sides=twice square on half the base and twice square on line joining vertex and middle of base; $\therefore$ L B^2+B C^2=2 A C^2+2 A B^2; B L=K D $\therefore$ K D^2=3625. Similarly E F^2=2800; H G^2=1825. Area=8250. (12.) 3 : 1.

VII.—Page 236.

(1.) Asking price=\$1.40; reduces this 15%. $\therefore$1.40 $\times$.85=1.19, selling price=gain of 19%, &c. \$5263$\frac{3}{19}$. (2.) \$4.8665—\$4.84=\$.0265 = gain on \$484=$\frac{265}{484}$%. (3.) Bank discount=5300 $\times\frac{3}{4}\times$ rate per unit; true discount=5300 — 5300$\div(1+\frac{3r}{100})$= 1.5900r. $\div$ (400+3r) 53r^2—24r=3200 : $\therefore$ r=8. (4.) 25% on $\frac{3}{4}$=18$\frac{3}{4}$% on whole; 10% loss on $\frac{1}{4}$=2$\frac{1}{2}$% on whole $\therefore$ 18$\frac{3}{4}$—2$\frac{1}{2}$= 16$\frac{1}{4}$% = real gain=1000 $\therefore \frac{80000}{13}\times$cost; $\frac{80000}{13}\times\frac{3}{4}\times$

$\frac{1}{10}=\frac{6000}{13}$=loss; $\frac{200000}{13}\times\frac{25}{100}=\frac{50000}{13}$ = gain $\therefore$ loss=$\frac{10000}{13}=76\frac{12}{13}$. (5.) $\frac{5\frac{2}{5}\times100\times17\frac{1}{2}\times10000}{185\times220}=£2321\frac{355}{407}$. By direct exch. $:£2045\frac{5}{11}$ $\therefore$ gain=$£276\frac{168}{407}$. (6.) 10160 lbs. of 1st, 15240 of 2nd, 25400 of 3rd; cost \$7620 + one year's interest \$533.40+rent \$200=\$8353.40+5% of this=\$8771.07 to be realized by end of year. First sale=\$4572=interest 9 months, \$240.03=\$4812.03; second sale=\$889+interest 6 months, $\$31.11\frac{1}{2}=\$920.11\frac{1}{2}$ $\therefore$ Amt. to be realized on remaining quantity=$\$3038.92\frac{1}{2}$, which divided by 12700 gives $23\frac{47}{50}\frac{17}{80}$ cents. (7.) Total stock \$14600. A gets $\$62\frac{1}{2}$ gain in 1 month; B \$40; C \$80; prop.=25, 16, 32: A \$5000; B \$3200; C 6400. (8.) At the time of purchase there is due \$18, in 6 months \$218, in 12 months \$12, in 18 months \$212, in 2 years \$6, in $2\frac{1}{2}$ years \$206. P. W. of these at 8% comp. int. are \$18, \$219.62, \$11.11, \$188.75, \$5.14, \$169.83. (9.) By similar triangles and Euclid iii. 36 : P. Q. $\times$ P.R. = $\left(\frac{2\ r,\ r,}{r-r',}\right)$, r, r′ being the radii. (10.) [*a*] 12.5664; [*b*] 7.79+; [*c*] 78.54; [*d*] 3.4641016.

VIII.—Page 238.

(1.) Multiply both terms of second fraction (in the brackets) by 2^3, of third fraction by 2^5, &c. 3.14159+. (2.) $(\frac{6}{5})^4$ of capital—\$2684=18052. Capital=\$10000. (3.) \$5100; \$4850. See "Ex. Papers," page 17, q. 7. (4.) P. W. by Bank discount=P—Prt.; this in t years will amount to P—P r^2 t^2 instead of P; error= P r^2 t^2; $\therefore$ error varies as square of time, P and r being constant. (5.) 5 : 4. See "Ex. Papers," page 30, q. 18. (6.) $\frac{92}{100}$ ($\frac{13}{20}$ of liabilities + \$2000)=$\frac{69}{100}$ of liabilities, &c. Liabilities=\$20000; assets=\$15000.

(7.) $\$236\frac{8}{17}$. See "Ex. Papers," page 31, q. 20. (8.) $\frac{5000}{.97} \times 1.04 + \frac{5000}{1.05} \times .99 = 10075\frac{75}{679}$. $\therefore 75\frac{75}{679}$ gain. (9.) Correct solution, as may easily be shown from analysis of q. 7, page 17, "Ex. Papers." (10.) Depth of water $\times 9 = 36 \times 36$ (Euclid iii. 35). $\therefore$ depth $= 144$ inches. (11.) (a) 84.63+ long; 52.39+ wide. (b) 34.6 long; 25.5 wide; 13.84 thick.

IX.—Page 240.

(1.) $\frac{2}{5}$ at loss of $12\% = 5\%$ on whole; $\frac{3}{10}$ do $= 4\frac{1}{2}\%$ on whole; $\frac{3}{10}$ at gain $40\% = 12\%$ gain on whole, &c. $\frac{5}{6}\% = \$25$. $\therefore$ cost $= \$3000$. (2.) See Canadian Edition Hamblin Smith's Arithmetic. (3.) Cost $= \$1400000$; consumption in second case $= \$980000$, and revenue $= \$198000$, which is 25% of $\$784000$. $\therefore$ there is a falling off of $\$196000 = 20\%$. (4.) Tea, 75 cents; coffee, 32 cents. (5.) 146 guns. 5 rounds in 8 minutes $= \frac{5}{8}$ round in minute, and 8 rounds in $10 = \frac{10}{8}$ in 1 minute, &c. (6.) P.W. of \$1 (simple interest) $= \$\frac{3}{5}$, which amounts to $\frac{21}{25}$ in 4 years. $\therefore$ loss $= \frac{4}{25} = \$160$; and debt $= \$1000$. For two years loss would be \$40; for 8 years \$640. See Paper VIII. q. 4. (7.) 5400 miles. (8.) Amount insured $= \$11520$; $\therefore$ value of goods + premium of insurance + \$40 $= \$11520$. Value of goods $= \$11048$. (9.) \$1298.67. See "Ex. Papers," page 31. q. 20. (10.) (a) Similar solids are as cubes of like dimensions $\therefore 105 : 2268 :: 7^3 : x^3 : 42$ length. (b) $1 : \frac{1}{2} :: 18^3 : x^3$. Slant height $= 9\ (2 - \sqrt[3]{4})$.

X.—Page 242.

(1.) $(1.20)(1.37\frac{1}{2}) = \$1.65$ end of 2nd year; $\$1.65 \times .60 = .99$ end of 3rd year; $\$1.00 - .99 = \$.01$ loss on every dollar: \$20,000. (2.) \$4.70 = cash price $\$4.70 \div .94 =$

\$5, 6 months' price; \$5÷1.3=\$3.84$\frac{8}{13}$ = cost price; \$5×.96=\$4.80=3 months' price \$4.80—3.84$\frac{8}{13}$=95$\frac{5}{13}$ cents. (3.) 16 miles. See "Ex. Papers," page 26, q. 12. (4.) £96=1920s. $\frac{3}{20}$ of 1920=288, do of 56=8$\frac{2}{5}$; 56—38=18. ∴ (18—8$\frac{2}{5}$)×No. quarters=288; No. quarters=30. (5.) It will be found that 17 of first gang= 6 of second gang. ∴ ($\frac{150}{17}+\frac{510}{17}$) of second gang can do work in 1 day, &c. 7$\frac{10}{17}$ men ∴ 8 is least number. (6.) Interest (payable annually)=\$1200. Then a sum (a) must be raised annually, to amount to \$20,000 in 10 years, *i.e.* 20,000=a ($1.06^9+1.06^8+ \ldots +1$), and a =\$1517+together with \$1200 interest. (7.) 5.78064; 1.8377+. (8.) 90 oxen. See "Ex. Papers," page 24, q. 6. (9.) A's profits=$\frac{3}{8}\times\frac{7}{2}+\frac{1}{2}=\frac{29}{16}$ in 4$\frac{1}{2}$ years. In last 2$\frac{1}{2}$ years his profits=$\frac{7}{6}\times\frac{2340}{3}\times\frac{5}{4}=\frac{16315}{1152}$. ∴ his total profits=$\frac{16315}{1152}+\frac{29}{16}=\frac{371952}{1152}$=\$17180, and annual profits=17180×1152÷3719. (10.) (a) A right angled triangle. ∴ area=638×720÷2 (links)=2.2968 acres. (b) 169.17×3.1416. (c) 12.76275.

XI.—Page 244.

(1.) Cost=\$23.34, duty=\$2.91$\frac{3}{4}$. ∴ total cost=\$26.25$\frac{3}{4}$. Also 189 sold for 192, at 25 cents=\$48, giving gain \$21.74$\frac{1}{4}$=82%. (2.) \$20000 cost in N. Y. \$21500 currency. Again, exchange being at 9$\frac{3}{4}$, we give 109$\frac{3}{4}$ for 109$\frac{1}{2}$. ∴ In London cost is $70\frac{1}{2}\times\frac{109\frac{3}{4}}{109\frac{1}{2}}\times\frac{20000}{100}\times\frac{139}{100}$ = \$19961.09 currency. ∴ Gain \$1538.91 currency by buying in London. (3.) \$73 due at once (April 5), \$145 in 33 days, and \$600 in 100 days: p. w. at 5%=73+ 144.34+591.90=809.24, which amounts to \$818 (=sum of debts) in $\frac{438}{2045}$ of a year=78+days. (4) T. D.—B.D. =Prt.$-\frac{\text{Prt.}}{1+\text{rt.}}=\frac{\text{Prt.}}{1+\text{rt.}}\times\text{rt.}=\text{rt}$% on the T. D. (5.) 24% of outlay=\$585=24% of $\frac{13}{10}$ of cost, &c. \$1875.

(6.) $300\times1\frac{1}{3}=\$4$; received \$2.38 $\therefore$ loss \$1.62. For every orange eaten $1\frac{1}{3}$c.$+4\frac{2}{3}$c.$=6$c. $\therefore$ $162\div62=7$ oranges eaten: 273 sold. (7.) \$310. (8.) A 1 row in $\frac{6}{25}$ hour, B 1 in $\frac{4}{15}$ hour, C 1 in $\frac{2}{5}$ hour; L.C.M.$=\frac{1}{5}^2$ hours. $\therefore$ sums in prop. of 10, 9, 6. A, \$20.20; B, \$18.18; C, \$12.12. (9.) \$8500—expenses and commission= \$8046.70. \$100$\frac{3}{8}$ of this gives consignor \$100, &c. \$8016.63. (10.) B's as unit (=1), A's $\frac{4}{5}$. $\therefore$ $(1+\frac{4}{5})$ $(1.1)^4=\$14641$, &c. A's \$4838.70, B's \$6451.61. (11.) (*a*) 12; (*b*) vol. of cavity as unit, then 2 is that of shell; r, r′ radii; then $r^3 : r'^3 :: 1 : 2$. $\therefore$ $r'=r\sqrt[3]{2}$; thickness $=r\sqrt[3]{2}-r=r(\sqrt[3]{2}-1)$.

XII.—Page 246.

(1.) It is found that discount$=\frac{1}{17}$ of face of note: 8% per 360 days$=\frac{1}{45}$% per day, or discount$=\frac{1}{4500}$ of face per day $\therefore$ $\frac{1}{17}\div\frac{1}{4500}=265$ days. (2.) $\frac{47}{100}-\frac{43}{100}=\frac{4}{100}=$ 80; $\therefore$ 2000 votes. (3.) A begins work at 6 o'clock a.m.; in the afternoon B's energy diminished in ratio of 4:3. A's work in 6 hrs.—B's work in $5\frac{1}{2}$ hrs.$=\frac{1}{20}$, &c. A will be found to do $\frac{12}{241}$ of the work in 1 hour, and B $\frac{109}{2410}$. $\therefore$ A will have done $\frac{132}{241}$, and B $\frac{109}{241}$; 132:109. (4.) $\frac{15\frac{3}{4}}{20}\times4\frac{4}{9}\times1.09\frac{1}{2}\times1.35$=value in N. Y. without duty. $\therefore$ $\frac{15\frac{3}{4}}{20}\times4\frac{4}{9}\times1.09\frac{1}{2}\times1.35\times1.50\times1.25=\$9.701$. (5.) R= amount of \$1 for one year at given rate. Then $200(R^2+R+1)=800$, &c.; rate% $=30.27+$. (6.) $(1.04)=$ value of each \$1 stock end of year. $100(1.04^2-1)=$ \$8.16 = interest due end of year on each \$100 stock; $\therefore$ $8.16\times\frac{98\frac{3}{4}}{112}=7.2$% nearly. (7.) Sterling cost $=\frac{\$4.44}{20\times1.85}\times 1s.=12s.$ $\therefore$ $\frac{1}{20}\times4\frac{4}{9}\times(1.09\frac{1}{2}+\frac{1}{8})+75c.=3.67\frac{1}{2}$ total cost. $\therefore$ gain $=76\frac{1}{2}$c. on $3.67\frac{1}{2}$; cost $=20\frac{20}{147}$%. (8.) A's gain

$258; B's $405. (9.) 44 yds. in 3 sec. = 30 miles per hour; 44 yds. in $2\frac{1}{12}$ sec. = $43\frac{1}{5}$ do. ∴ A and B approach each other at rate of 13.2 miles per hour. When the train met B it was 15 miles ahead of A, and A and B are 15 miles apart. ∴ $\frac{15}{13\frac{1}{5}} \times 6 = 6\frac{9}{11}$ = distance A makes after train met B, but he had also travelled 3 miles while train was going to B. ∴ $6\frac{9}{11} + 3 = 9\frac{9}{11}$ miles. (10.) Of plane quad. figs. square has greatest area, &c. $521.432.

XIII.—Page 248.

(1.) Expression$= \frac{\cdot 025^5(3^5 + 2^5)}{\cdot 025^4(3^4 - 3^2 + 2^4)} = \frac{5}{64}$, or .078125. (2.) $2\frac{3}{4}\%$ = $198.25 ∴ net income = $7209\frac{1}{11}$; ∴ amount before repairs, &c., are paid for = $7209\frac{1}{11} \times \frac{108\frac{4}{7}}{100}$; also of $100, $95 remains after paying agent's fee. ∴ $7209\frac{1}{11} \times \frac{108\frac{4}{7}}{100} = \frac{95}{100}$ of gross rents, which ∴ = $8238\frac{4}{77}$. (3.) True p. w. $= \frac{A}{1+rt}$, commercial p. w. = A —Art. Then (1) difference $= \frac{Ar^2t^2}{1+rt}$, &c. (2) $71\frac{13}{160} = \frac{P}{n}$, and $63\frac{17}{20} = \frac{P}{n+1}$. ∴ n = 8, &c. ∴ P = $574\frac{13}{20}$, rate $\% = 6\frac{1}{4}$. (4.) Amount of $1 @ 3% half-yearly $= \sqrt{1{\cdot}03}$ quarterly. Amount of $1 for 23 payments $= (\sqrt{1{\cdot}03})^{23}$ Amount of $1 for 22 payments $= (\sqrt{1.03})^{22}$ &c., &c. ∴ Total amount $= \frac{\sqrt{1.03}^{24} - 1}{\sqrt{1.03} - 1} = \frac{1.03^{12} - 1}{\sqrt{1.03} - 1}$. Also amt. of $1000 for 6 years at 10% = 1000 $(1.1)^6$. ∴ 1000 $(1.1)^6$ ÷ above result = &c. (5.) $1701 = cost. $340.20 = legitimate gain. ∴ $\frac{\$1701+\$340.20}{\$1711+\$379.20}$ of 1 yd = 2 ft. $11\frac{11}{34}\frac{27}{67}$ inches. (6.) $120000000. (7.) m and M mass of E. and J. respectively, r and R radii, a and A attn. Then $m R^2 : M r^2 :: a : A$. But mass is proportioned to vol. × density

and radii to cube roots of vols. $\therefore 1 \times 1 \times R^2 : 1387.431 \times .22 \times r^2 :: a : A$, &c. 39.40+. (8.) See "Ex. Papers," p. 27, q. 14. (9.) See "Ex. Papers," p. 29, q. 17. (10.) [*a*] Find radius of circum. : circ. $:= 20 \times 30 \times 25 \div 4$ $\sqrt{\frac{7}{2} \times \frac{3}{2} \times \frac{1}{2} \times \frac{2}{2}} = \frac{40}{\sqrt{7}}$ { Observe that quant. under radix sign. } $= 5^6 \times 3^2 \times 7 \div 2^4$. [*b*] $16\frac{2}{3}$.

XIV.—Page 250.

(1.) $(\frac{12}{100} \times \frac{26}{25} \div \frac{23}{25})$ of $100 = 136\frac{18}{23}$: Ans. $36\frac{18}{23}\%$. (2.) *Six* months' credit price of silk $= \$2.16\frac{2}{3}$; $\therefore$ he should receive for the silk $(2.16\frac{2}{3} \times 60) \div 2 = 65$ yards. (3.) A's gain on \$1 in 1 month is $\$\frac{1}{100}$; B's gain for unknown time $= \$\frac{1}{10}$. $\therefore \frac{1}{10} \div \frac{1}{100} = 10$ months, B's time. C's stock will be found to be \$1000. (4.) $2400 \div 20 = 120$, annual payment. $177.60 - 120 = 57.60$ interest on sum not yet paid; but interest is $\frac{3}{50}$ of that sum $\therefore$ sum $= \$960$: Ans. 12. (5.) Both hands together must have passed through all the spaces of the dial plate. Minute hand 60 spaces, while hour hand 5 (both $= 65$) $\therefore \frac{60}{65}$ of $5 = 4\frac{8}{13}$ min. spaces, what the minute hand was in advance; at 2 o'clock $\therefore$ the minute hand had $10 + 4\frac{8}{13}$ spaces to gain; gains 55 in 60; $\therefore 15\frac{13}{14}\frac{5}{3}$ Ans. (6.) 3 months. (7.) $16\frac{5}{7}\frac{6}{5}\%$ gain. $13\frac{1}{3} \times 2\frac{1}{5} \times 1000 = 29333\frac{1}{3}$ francs; this *minus* commission $(146\frac{2}{3})$ gives gain $4186\frac{2}{3}$, &c. (8.) $\$424.61\frac{7}{13}$. *Net* income $=$ \$2640; sells for $\$3000 \times 24 = \$72000$. New income $= \frac{3}{97\frac{1}{2}} \times 72000 = \$2215.38\frac{6}{13}$, &c. (9.) $49\frac{5}{8}$ feet $= 7146$ inches; $1\frac{1}{2} \times 1\frac{1}{2} \times 2 = 4.5$, and $7146 - 4.5 = 7141.5 =$ contents of 6 square boards the box is made from $\therefore 7141.5 \div 6 = 1190.25$, sq. root of which $= 34.5$; $34.5 + 1.5 = 36$. (10.) 2040·94+. Let H + F = width of house, E position of eye, A B that of fence; draw B D perpendicular to

E A produced; then since triangle A B D is right angled and isos. we have 2 A D^2=A B^2=90^2; B D=63.64 rods, and the similar triangles E F H and E D B give H F : E F : : B D : E D=1750.1 ft., &c.

XV.—Page 252.

(1.) (1) 19.104, or 19.105. (2) It will be found that $\sqrt{6}=\sqrt{2+\sqrt{3}}+\sqrt{2-\sqrt{3}}$ which divides the numerator; giving $(\sqrt{2+\sqrt{3}})^2-\sqrt{4-3}+(\sqrt{2-\sqrt{3}})^2=3$. (2.) $6\frac{2}{3}$ months. (3.) The No. will be of form $a+10b+10^2c+10^3d+\ldots$ Subtract $a+b+c+\ldots$ ∴ Remainder $=(10-1)b+(10^2-1)c+(10^3-1)d+\ldots$ when each of the expressions 10—1, 10^2—1, &c., consists of a series of *nines* and is ∴ divisible by 9. Also if N be a number and s the sum of its digits, $N=9n+s$, where 9n contains 3 and 9 whatever n may be. ∴ N will be a multiple of 3 or 9 if s is. (4.) $\frac{4}{9}\times\frac{3}{10}\times\frac{1}{10}=\frac{1}{75}$ (of cost) = increase in materials; $\frac{3}{5}\times\frac{1}{3}\times\frac{1}{2}\times\frac{1}{8}=\frac{1}{80}$ = increase in cost of labour. ∴ ultimate cost $=1+\frac{1}{75}+\frac{1}{80}=1\frac{31}{1200}$. ∴ net gain $=1\frac{1}{20}-1\frac{31}{1200}=\frac{29}{1200}=2\frac{5}{12}\%$. (5.) The circuitous course is more advantageous by 124.8325 milrees. (6.) Rate of st. is represented by $\frac{1}{2}(5-3)=1$; rate of boatman in still water is represented by $\frac{1}{2}(5+3)=4$. ∴ rate of st. $=\frac{1}{4}$ his rate in still water. Also in second supposition $\frac{1}{2}(2+1)=1\frac{1}{2}$ represents rate in still water, and $2-1\frac{1}{2}=\frac{1}{2}$ rate of current $=\frac{1}{3}$ rate in still water. ∴ $\frac{1}{3}-\frac{1}{4}=\frac{1}{12}$ of rate in still water $=\frac{1}{2}$ mile per hour. ∴ rate = 6 miles. (7.) \$3138.92+. (8.) $6\frac{11}{24}:2\frac{32}{35}$. (9.) $9\frac{6}{11}$ minutes past 8. (10.) Sides containing the right angle $=\frac{29\pm\sqrt{41}}{4}$.

XVI.—Page 254.

(2.) 12 hours. (3.) (1) $12\times18\times5\times25=27000$. (2) L. C. M. of $49\frac{1}{2}$ and $52\frac{1}{4}=940\frac{1}{2}$; they will pass the

point every $940\frac{1}{2}$ minutes, *i.e.* 19th train on first track and 18th on second. Again, $52\frac{1}{4}-49\frac{1}{2}=2\frac{3}{4}$, and $27\frac{1}{2}\div 2\frac{3}{4}$ $=10$ *i. e.* 10th (on first track) passes at the given time, and 9 are still to pass $\therefore 9\times 49\frac{1}{2}=445\frac{1}{2}$. minutes. (4.) $8\frac{1}{2}$ per cent. (5.) $a+10b+10^2c+10^3d+\ldots$ be one No. and $c+10a+10^2d+10^3b+\ldots$ second No. with same digits. $\therefore$ difference $=(10-1)a+(10^3-10)b-d(10^3-10^2)-c(10^2-1)+\ldots=(10-1)a+10b(10^2-1)-10^2d(10-1)-c(10^2-1)+\ldots$ when each expression is divisible by $10-1=9$. (6.) If O be the point which A passes an hour ahead of B, the required point will be $2\frac{1}{16}$ miles from O; the time will be $3\frac{5}{8}$ hours. (7.) See Canadian Edition of Hamblin Smith's Arithmetic. (8.) A pays $\$74\frac{13}{16}$ too much, B pays \$39.75 too little, C pays $35\frac{1}{16}$ too little. (9.) In $7\frac{1}{2}'$ 12 taps empty the quantity + which runs in in $7\frac{1}{2}'$. In 1' 12 taps empty $\frac{2}{15}$ of quantity + what runs in in 1' So in second case: in 1' 7 taps empty $\frac{1}{16}$ of quantity + what runs in in 1'. $\therefore$ 5 taps empty $\frac{2}{15}-\frac{1}{16}=\frac{17}{240}$ in 1'; and it will be found that what runs in in $7\frac{1}{2}'=\frac{11}{40}$ of the quantity in the tank at first, &c. 4 taps, Ans. See "Exam. Papers," page 24, q. 6. (10.) $2\sqrt{19}-4$. The chord is side of equilateral triangle and bisects radius; if x=side of square, then $(15+x)(5-x)=\frac{x^2}{2}$, &c.

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(1.) $\$99\frac{1}{13}$ each cask. Capital as unit then $\frac{26}{25}+\frac{1}{10}$ of $\frac{26}{25}=\frac{143}{125}=6\times 104.50$, &c. (2.) [*a*] $\$19.23\frac{1}{13}$; interest $=10$. $\therefore$ 20 for twice time $=\frac{1}{12}$ of principal. $\therefore$ discount $=\frac{1}{13}$. [*b*] $250\div(1+r)^n=240$. $\therefore (1+r)^n=\frac{250}{240}$ and $240\div\frac{250}{240}=\$230.40$; $250-230.40=\$19.60$. (3.) $320\frac{5}{6}$ yards: cost price $=\$\frac{78}{77}$; gain at cash price $=\$\frac{6}{5}-\$\frac{78}{77}=\$\frac{72}{385}$, &c (4.) Let *a* be the sum payable every two years. Present

value$=a\div\{(1.05)^2-1\}\therefore 1000=\frac{100}{.05}\div\frac{a}{1.05^2-1}$ and a=\$102.50. (5.) $59\frac{3}{7}$ seconds. See "Solutions," Sec. V., Prob. 9. (6.) Board contains 3242 sq. inches; $2.5\times2.5=6.25$ inches, $3242-6.25=3235.75$, which divided by 7 gives 462.25, sq. root of which$=21.5$. And $21.5+2.5=24$ inches the width of box, height 12, length 48; inside dimensions 19, 7, 43, $\therefore$ contents$=5719$ cubic inches. (7.) A should have received $\frac{5}{9}$ of $90=50s.$, B & C $\frac{4}{9}$ of $90=40s.$; but B suffers $3.75s.$ loss by employing C. Hence the following:—B's sum : A's sum $(=50s.)$ :: B's loss $(=3.75s)$: A's loss $\therefore$ B's sum $\times$ A's loss $=50\times3.75=187.5s.\therefore$ also, it is easily found that B's sum $+$ A's loss $=36.25s.$; half of this is 18.125 and $(18.125)^2-187.5$ = square of half difference of B's sum and A's loss, and the *sum* and *difference* of these being known, we have $30s.$ = B's sum, and 6.25, A's loss. B received $30s.$, C $40-30=10s.$ $\frac{90}{30}\times5=15$ days, B's time; and $\frac{90}{110}\times2=18$, C's time. (8,) A \$3, B \$3.60, C \$4. A 5 inches, B $7\frac{1}{2}$ inches, C $18\frac{1}{2}$ inches. (Small fractions neglected in the solution.) (9.) 2.445 + inches.

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(1.) $\frac{2}{3}$ of 1st bar is silver, $\frac{9}{11}$ of 2nd bar is silver. There are to be 24 lbs. of metal in new bar; if whole of it were taken from 1st bar it would contain 16 lbs. of silver; but it is to contain 19 lbs. of silver, a loss of 3 lbs., but loss from every lb. not taken from 2nd bar is $\frac{5}{33}$, and then No. of lbs. that should be taken from 2nd bar is 3 lbs. $\div\frac{5}{33}=19\frac{4}{5}$, and $24-19\frac{4}{5}$ = No. of lbs. to be taken from 1st bar $=4\frac{1}{5}$ lbs. (2.) 46080. (3.) The last clause should read: "A will then have \$200 more than B." After 1st transaction A's will be \$200 less than it

was, and B's $\frac{6}{5}$ of A's first capital less \$240; after 2nd transaction A will have $\frac{6}{5}$ of his first capital—\$240, and B will have $\frac{5}{5}$ of A's first capital—\$200, but this is \$200 less than A's $\therefore \frac{5}{5}$ of A's $= \frac{6}{5} + 240$, $\frac{1}{5} = \$240 \therefore$ A's capital was \$1200 and B's \$900. (4.) There is a common factor, and 8 times this factor is No. of bushels in 1st kind; 9 times this factor is No. of bushels in 2nd kind; 8 times this factor + 12 bushels = No. of bushels of 1st kind after the 12 bushels have been added, &c. 96 of 1st kind and 108 of 2nd kind. (5.) 2 years @ 10% per year is same as 20% for 1 year $\therefore$ 600—$\frac{1}{5}$ of note = \$1000—note $\therefore \frac{4}{5}$ of note = \$400 $\therefore$ note = \$500. (6.) The commission merchant gets on an average $\frac{1}{1}\frac{1}{3}\frac{1}{3}$ of all he invests, but he gets $\frac{1}{2}\frac{1}{1}$ of the cash he invests, $\frac{2}{2}\frac{}{1}$ of the value of pork, and $\frac{3}{3}\frac{}{5}$ of wheat. Now, by allegation it is easy to find what proportionate parts must be taken of cash, pork and wheat to give an average of $\frac{1}{1}\frac{1}{3}$; then divide \$13300 in the ratio of these proportionate parts—one answer—cash \$1540, pork \$1960, wheat \$9800. (7.) \$4000 in 4 years amounts to \$4862.025 $\therefore$ interest for remaining time = 5000— \$4862.025 = \$137.975; but interest on \$4862.025 for 1 year = \$243.10125 $\therefore$ the time will be 4 years + $\frac{137.975}{243.10125}$ of a year = 4 years, 109 days.—Ans. (8.) \$4.70. See Paper 10, q. 2. (9.) 4 weeks. (10.) 50.99.

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(1.) 32 days. A \$2.70; B \$1.80. (2.) Let A be the estimated cost, a the actual cost, R^1 the rate of increase of debt through accruing of interest from date of issue of debentures to date of first payment; R the annual rate of increase thereafter, n the original number of payments, m the number of payments still due at time of adjustment, there having been $n-m$ payments made. Hence

at date of last made payment the amount yet due is by estimate $\frac{m}{n}$ A, but up to date the accrued value of excess of estimate over actual cost is (A—a) R^{n-m-1}; hence the amount actually due is $\frac{m}{n}$ A—(A—a)$R^1 R^{n-m-1}$, and the annual payment will be $\frac{A}{n} - \frac{A-a}{m} R^1 R^{n-m-1}$, plus the accrued interest on the unpaid part of $\frac{m-A}{n}$—(A—a) $R^1 R^{n-m-1}$. Suppose p=the number of payments yet to make, and not being greater than *m*, the first of these will be $\left\{ \frac{A}{n} - \frac{A-a}{m} R^1 R^{n-m-1} \right\}$ $\left\{ p\ R - (p-1) \right\}$; since this is the first payment after $n-p$ have been made it may be called $n-p+1$ payment. A=\$79. a=\$76, $R^1=\frac{378088}{365000}$, R=1.06; n=5, m=2, *p*=2 and 1; hence the fourth and fifth payments should be respectively $\$ \left\{ 15.80 - 1.50 \times \frac{378088}{365099} \times 1.06^2 \right\} \times 1.12=$ \$15.74, and $\$ \left\{ 15.80 - 1.50 \times \frac{378088}{365000} \times 1.06 \right\} \times 1.06=$ \$14.90. In the second case the fourth and fifth payment, may similarly be found to be \$18.98 and \$17.96 respectively. (4.) 1 eagle=232 grs., 15432 grs.=1 kilo. pure gold, 9 kilos. pure gold=10 do. st. gold, 1 kilo. st. gold =3100—6.30 francs ∴ 1 eagle=51.6765 francs. (5.) 3:2. (6.) 25 r=3—3÷$(1+\frac{r}{12})^{120}$. (7.) This depends on the principle that if a No. N consists of *n* digits a, b, c . . s then N—a+b—c+ . . . is divisible by 11. From this it follows that N will be of the form $11n+(a-b+c-d+\ldots)$, or $11n+(a+c\ldots.)-(b+d\ldots)$, and will ∴ be a multiple of 11 if $(a+c+\ldots)-(b+d+\ldots)$ is so. (8.) 200 @ 50, 500 @ 70, 250 @ 90. (9.) $(2.60\times\frac{90}{100}-2.60\times\frac{100}{130})\div 2.60\times\frac{100}{130}=17\%$. (10.) A B=25, B D=$25\sqrt{3}$, D C=$50\sqrt{3}$, B C=75.

XX.—Page 261.

(1.) The difference between simple and compound interest for each year is the interest on the interest. The

amount of \$45 for 4 years=\$54.69778125, or the amount of \$1=$\frac{54.69778125}{45}$=1.21550625=$(1.05)^4$ ∴ 1.05 is the amount of \$1 for one year, hence the rate is 5%; sum=$\frac{45}{.05}$=\$900. (2.) $\frac{400}{1.05}+\frac{400}{1.1}+\frac{400}{1.15}$=\$1092.51, Ans. (3.) $1+(1.04)+(1.04)^2+(1.04)^3$=4.246464=amount of an annuity of \$1 for 4 years; $\frac{160\times4.246464}{(1.04)^4}$=\$580.7832. (4.) If $\sqrt{3}$ be the depth, the radius of the base is 1, ∴ area of base=$\frac{22}{7}$, area of base×$\frac{1}{3}$ $\sqrt{3}$=$\frac{22}{21}$ $\sqrt{3}$=vol. when the depth is $\sqrt{3}$. Similar cones are to each other as the cubes of their like dimensions $\frac{22\sqrt{3}}{21}$: 400 gals.× 274.274 :: $(\sqrt{3})^3=3\sqrt{3}$: 66.14 inches or 5 feet 6 inches. Ans. (5.) Present worth of \$620 is \$600= cash cost of goods; $600+\frac{600}{10}$=\$660=cash selling price; $1.01\frac{1}{4}\times660$=\$668$\frac{1}{4}$=credit selling price; 668$\frac{1}{4}$+10= \$678$\frac{1}{4}$=credit selling price in second case. Present worth of \$678$\frac{1}{4}$ for 6 months at 5%=\$661$\frac{29}{41}$; therefore \$600 gained \$61$\frac{29}{41}$, or \$100 gained \$10$\frac{35}{123}$. (6.) $\left.\begin{matrix}20\times60=1200\\70\times70=4900\end{matrix}\right\}$=6100c., cost of 90 lbs. or 67$\frac{7}{9}$c. per lb.=cost of mixture of the first and second kind. By selling the whole mixture at \$1 and allowing 10% discount to the purchaser and gaining 10% would make the cost of the mixture 81$\frac{9}{11}$ cents per pound; 81$\frac{9}{11}$ $\left\{\begin{matrix}\left(\frac{67\frac{7}{9}}{100}\right)=18\frac{2}{11}=1800\\=14\frac{4}{99}=1390\end{matrix}\right\}$ The relation between the 90 pounds and what was mixed with it at \$1 per pound 1800 : 1390 :: 90 : 64$\frac{1}{2}$ pounds = required quantity. (7.) $\frac{2000\times100\times240}{102\times4.86\frac{3}{4}\times4}$=24174 yards nearly; 24174×.12= \$2900.88=credit sale price of cloth. The present worth of \$2900.88 for 1 year at 8%=\$2686; \$130 for three months at 8%=\$127$\frac{23}{51}$; \$2000+\$127$\frac{23}{51}$=\$2127$\frac{23}{51}$ = money advanced which gained \$2686 − \$2127$\frac{23}{51}$, or \$558$\frac{28}{51}$. If \$2127$\frac{23}{51}$ gains \$558$\frac{28}{51}$, \$100 will gain \$20$\frac{5}{9}$.

nearly. (8.) 6 : 5. (9.) 3 feet. (10.) $120+\frac{120}{1.08}+\frac{120}{(1.08)^2}$ $=\$333\frac{53}{54}$=present value of fencing; $\frac{8000}{5}+333\frac{53}{54}=1933\frac{53}{54}$—the money invested; 20 years' purchase is equal to 5% ∴ the income from the farm is $\frac{8000\times5}{100}-50-\frac{6400\times4}{100}=\$94$. If $1933\frac{53}{54}$ gains \$94, \$100 will gain \$4.8.

XXI.—Page 263.

(1.) A 15 days; B 30 days. (2.) $\sqrt{1.06}=1.029563$; multiply by 1000 and subtract the principal. \$29.563 Ans. (3.) If whole distance is only 3 miles, and each sec. 1 mile, it will require $(\frac{1}{30}+\frac{1}{35}+\frac{1}{40})$ of an hour to run 3 miles. ∴ 3÷this time$=34\frac{38}{73}$. (4.) Present value of notes=\$89+\$41.98=\$130.98, which put out for $\frac{189}{365}$+of year amounts to \$135; divide \$130.98 by \$135 gives present value of \$1; find the time. In the work there will be the log. 9.98687 or $\bar{1}$.98687, which is really—0.01313, and requires to be put in this form. (5.) Nine weights, 1, 3, 9, 27, 81, 243, 729, 2187, 6561. 7961 can be weighed by putting 27, 2187, and 6561 in one scale, and 1, 3, 81, 729 in the other. A peculiar question. Every number can be evidently expressed in the ternary scale, and no number need be greater than 1 if we introduce a(−1)when necessary. (6). $\frac{1000(1.03^{40}-1)}{1.05^{20}-1}=1368.19$. (7.) \$6000; $1\frac{1}{3}$ per cent. (8.) $2\frac{1}{2}$ per cent. (9.) \$110.40. (10.) \$150. (11.) 6 years. $120\,(1+\frac{x}{12})=24\,x\,(1+\frac{x}{24})$, solve.

XXII.—Page 265.

(1.) $\frac{41}{64}$; .640625. (2.) 381.46; 27.6. (3.) 2s. $4\frac{7}{16}$d. (4.) It loses 2 min. 24 sec. a week. (5.) .8 nearly. (6.) $128\frac{3}{4}\frac{1}{3}\frac{1}{8}$ grains. $(=\frac{11}{12}\times123\times\frac{15}{73}\times5\times\frac{10}{9}.)$ (7.) 5%. Fair gain$+\frac{1}{15}+\frac{1}{15}$ of fair gain$=\frac{3}{25}$ ∴ fair gain$=\frac{1}{20}=$ 5%. (8.) \$14000; $1\frac{1}{2}\%=\frac{1}{80}$ ∴ $1800-225-\frac{1}{80}$ cost = $\frac{1}{10}$ cost, ∴ &c. (9.) 35 : 32. (10.) $18\frac{1}{3}$ minutes.

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(3.) A $720; B $600. (4.) 50 miles. (5.) 20 gallons water, 120 gallons wine; cask 160 gallons. (6.) Cost to retail merchant $+10\frac{90}{121}$ of cost=$1.34, ∴ cost=$1.21=selling price of wholesale merchant; but cost to wholesale merchant + 10% cost=$1.21 ∴ cost to wholesale merchant=$1.10=buying price+10% of duty, ∴ buying price=$1. But duty off, and original price falling 10%, the buying price is 90 cents, wholesale price 99 cents, retail merchant's price $99\times\frac{134}{121}$ cents=1.09\frac{7}{11}$, ∴ he should sell it at a decrease of $24\frac{4}{11}$ cents. (7.) $3000. (8.) 200 shares @ $50, and 100 @ $110=$21000, ∴ he invests $3000 in stocks, of which $60 pays $6 dividend (paying $75 for $60 stock) ∴ 3000\times\frac{6}{75}$=$240. Also income from 200 shares and 100 shares @ 4% and 8% respectively=$1600 ∴ $2000=new income. But from $3000 he gets $240 ∴ from $18000 invested in Merchants' Bank at 90 he gets $1760 (from 200 shares), ∴ 1 share gives $8\frac{4}{5}$ and half-yearly dividend=$4\frac{2}{5}$%. (9.) 298\frac{4}{27}$. (10.) The mixture in cask A will be 26 gallons wine A, 19 wine B, 19 wine C; the mixture in cask B will be 26 gallons wine B, 19 wine C, 19 wine A; the mixture in cask C will be 26 gallons wine C, 19 wine A, 19 wine B. And these mixtures being sold at $182.60, $188.20, and $192.40, the selling price of wine A is $2.20, of wine B $3.00, and of wine C $3.60; ∴ *cost* prices are $2.00, $2.50, and $4.00 respectively.

XXIV.—Page 268.

(2.) A gives B a start of $\frac{1}{11}$ mile=480 feet; at end of 2 minutes A is 180 feet behind; he has ∴ gained 150 feet per minute. A 1650 feet; B 1500. (3.) 10%. (4.) Neglecting expenses, gross gain=847—122=$725;

gain on 1 bushel=$\$(\frac{5}{3}-\frac{7}{5})=\frac{4}{15}$; cost of 455 bushels lost=\$637, ∴ number bushels sold=$(725+637)\div\frac{4}{15}=5107\frac{1}{2}$; number bought=$455+5107\frac{1}{2}=5562\frac{1}{2}$. (5.) Had he bought $\frac{1}{4}$ less at original price amount would=\$45 less, ∴ number books=\$45÷50 cents=90; 1st number $=\frac{4}{3}$ of 90=120; cost of each=\$180÷120=\$1.50: selling price=$\frac{95}{100}$ of \$150=$1.42\frac{1}{2}$; marked price=$1.42\frac{1}{2}+.22\frac{1}{2}$=\$1.65. (6.) $\frac{5}{4}$ of 90=$112\frac{1}{2}$ yards; retail selling price=\$25 less than cost of $262\frac{1}{2}$ yards=cost 252 yards—\$9.25; ∴ cost of $10\frac{1}{2}$ yards=\$15.75:\$1.50 a yard. (7.) Let buying prices of teas be 6 and 7 monetary units respectively, ∴ selling price of first mixture=$\frac{3\times7+2\times6}{5}\times\frac{6}{5}=\frac{198}{25}$=also selling price of second mixture, ∴ *buying* price of second mixture=$\frac{10}{13}\times\frac{198}{25}=\frac{396}{65}$, which is greater than cost of the green by $\frac{59}{65}$, and less than that of the black by $\frac{6}{65}$. ∴ ratio is 6:59. (8.) \$6000. (9.) \$68+\$67=\$135=9% on the total, which ∴ = \$1500, interest on which at 4%=\$60; ∴ 68—60=8 interest on first sum at 1%. \$800; \$700. (10.) Area of circle=$(14400\times6\times3.1416)\div(4\times3.1416)=6\times3600$ =area of rectangle=6 squares each of area 3600= rectangle. 3 of these squares long and two wide=180 yards long and 120 wide; ∴ perimeter=600 yards. Cost of fencing, \$360.

XXV.—Page 270.

(1.) $38\frac{2}{11}$ miles. (2.) B's profit \$1500; whole amount invested $\$8333\frac{1}{3}$. (3.) $\$9702\frac{32}{77}\frac{4}{3}$. (4.) $\frac{4}{5}-\frac{3}{100}\times\frac{4}{5}+\frac{1}{2}-\frac{4}{100}\times\frac{1}{2}$=16000, &c. $\$12738\frac{109}{157}$=value of ship; $\$6369\frac{109}{314}$ =value of cargo. (5.) $\$6\frac{33}{82}$ per barrel. (6.) \$31250. (7.) His dividends amount to $8(1.04)^5+8(1.04)^4+8(1.04)^3+8(1.04)^2+8(1.04)+8=\frac{8(1.04^6-1)}{1.04-1}=53\frac{1}{3}$

nearly; $180+53\frac{1}{3}=233\frac{1}{3}$: $\frac{2\,3\,8\frac{1}{2}}{2}=119\frac{1}{6}$ very nearly. (8.) £90 will bring 3, or 100 stock will bring $\$4.86\frac{2}{3}\times 3=\$14.60$; sell. out at $90-\frac{1}{2}=89\frac{1}{2}$; No. of dollars will be $\frac{14.60}{3}\times 89\frac{1}{2}$. ∴ income will be $\frac{1\,4\,6\,0}{3\,0\,0}\times\frac{1\,7\,9}{2}\times\frac{1\,4}{1\,8\,6\frac{1}{2}}$, &c. Stock held will be £5525 17s. 5d., nearly. (9.) Amount given for the mortgage will be such that when put out on compound interest at 8% for the time to expire it will amount to 800+interest on different instalments at 8%. If there are four instalments still due, then statement will be: $A(1.08)^4=60(1.08)^4+248\,(1.08)^3+236\,(1.08)^2+224(1.08)+212$. (10.) He pays $1400(1.08^4+1.08^3+1.08^2+1.08+1)=5000(1+r)^5$; $\frac{7}{25}(\frac{1.08^5-1}{.08})=(1+r)^5$.

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(2.) L. C. M. × G. C. M. = product of the two numbers; then $100793\times 17=1713481$ = product of two numbers; $\frac{1\,2\,2\,4}{2}=612$ = difference between arithmetical mean and each of numbers; then $1713481+612^2=2088025$=square of arithmetical mean $\sqrt{2088025}=1445$=arithmetical mean. $1445+612=2057$ number; $1445-612=833$ number. (2.) \$288= income from $4\frac{1}{2}\%$; $\frac{2\,8\,8\times 8\,8\frac{1}{2}}{4\frac{1}{2}}$=price of $4\frac{1}{2}\%$ stock; and proceeds of $4\%=\frac{2\,8\,8\times 8\,8\frac{1}{2}}{4\frac{1}{2}\times 6\,0\,0\,0}=\$94$=price of \$100 stock after broker's charge is deducted; $94+\frac{1}{8}=94\frac{1}{8}$=price of stock. (3.) Buying price$-\frac{\text{Square of buying price}}{100}=\frac{\text{Buying price}}{100}\times$(100—buying price)=selling price. This is greatest when buying price×(190—buying price) is greatest; that is, when buying price$=\frac{1\,0\,0}{2}=$£50, when selling price = £25. (4.) A's rate of work : B's :: B's time before noon : $8\frac{3}{4}$ A's time after noon. A's rate of work : B's :: 6 B's time after noon : A's time before noon; hence B's time before noon : $8\frac{3}{4}$ :: 6 : A's time before noon, hence $8\frac{3}{4}\times 6$ =product of A's and B's time; $\frac{1}{2}:2=\frac{1}{4}$=difference between mean time

and time of each man; then as in (1) $\sqrt{8\frac{3}{4}\times 6+(\frac{1}{4})^2}=\frac{29}{4}$=mean time, and A's time=$\frac{29}{4}+\frac{1}{4}=7\frac{1}{2}$ hours, and he began at \$4.30 a.m. (5.) 5% ordinary stock+$7\frac{1}{4}$% of £400000 or £29000=6% ordinary stock+6% of £400000, or £24000 ∴ £5000=1% ordinary stock; £500,000= ordinary stock. (6.) 1 tap in 1′ discharges $\frac{4}{28}\times 17$ of what cistern holds+$\frac{1}{28}$ of what goes in in 1′; also 1 tap in 1′ discharges $\frac{1}{252}$ of what cistern holds+$\frac{1}{21}$ of what goes in in 1′; then $(\frac{1}{11}\frac{1}{9}-\frac{1}{252})$ of what cistern holds= $(\frac{1}{21}-\frac{1}{28})$ of what goes in in 1′; then $\frac{19}{51}$ of what cistern holds=amount going in every minute; whence cistern and what flows into it in $25\frac{1}{19}'$ will be emptied by 19 taps. (7.) The sum of the gains is $\frac{1}{100}$ (sum of squares of two parts of 90), and this latter sum is least when each part=$\frac{90}{2}$=45, hence sum of selling prices cannot be less than \$90+$\frac{2\times 45^2}{100}$ or \$130.50. (8.) Faster requires to gain 2″ so as to make its stroke at same time as slower, whether it is 2″ before or behind the slower; faster gains this 2″ in two strokes, since it gains 1″ every stroke; then when faster makes its 3rd stroke the other strikes also, and this afterwards happens at the seventh and eleventh strokes of faster, and no other. But whole number of strokes heard being 19, the faster must have struck 11. (9.) $4\sqrt{\frac{14641}{10000}}=1.10$, increase=10%. (10.) 144.21 feet. (11.) 61×200+31×required payment= 61×660—61×required payment, whence 92×required payment = 28060; required payment = $\frac{28060}{92}$ = \$305. (12.) 80 and 20.

XXVII.—Page 274.

(1.) $64\frac{1}{2}=\frac{3}{4}$ of 86%. ∴ he will receive $\frac{3}{4}$ as much at 36 as at 64%. 7% on $\frac{3}{4}$=$5\frac{1}{4}$% on whole, so that he gains $(5\frac{1}{4}-5)=\frac{1}{4}$% annually; gain on \$1 bonds=.00$\frac{1}{4}$=6%

of $\frac{100}{24}$ cents, which = ∴ cash gain on \$1 of bonds: $\frac{100}{24}$ cents gain represents \$1 bonds, ∴ \$258.33$\frac{1}{3}$ represents \$6200 stock. (2.) 4 bales + 6 times their increase in value for 1 month keep 12 Indians 9 weeks. ∴ 4 bales + 24 increase in value of 1 bale 1 month keep 108 Indians 1 week, and 1 bale + 6 increase in value of 1 bale 1 month keep 27 Indians 1 week; so from second supposition, 1 bale + 10 increase in value of 1 bale 1 month keep 21 Indians 1 week. ∴ 4 times increase in value of 1 bale 1 month keep 6 Indians 1 week, &c. ∴ 1 bale = 12 times increase in value of 1 bale 1 month, &c. \$72 Ans. See "Ex. Papers," page 24, q. 6. (3.) \$84 = 2% of \$4200 = $\frac{2}{100}$ of total cost of furs, storage, duty, and commission, which must ∴ be \$4000 = $\frac{705}{700}$ of total outlay in furs, storage, and commission, which outlay ∴ = $\frac{4000 \times 700}{705}$; but storage and commission = 250 + 84 = 334 ∴ original cost = 3971.63$\frac{37}{141}$ − 334 = \$3637.63$\frac{37}{141}$. (4.) Amount giving eldest son \$1 on coming of age = \$1 ÷ $(1.05)^4$; so for second son \$1 ÷ $(1.05)^6$; and for youngest \$1 ÷ $(1.05)^8$; ∴ eldest son's share = \$160000 × (\$1 ÷ 1.05^4) ÷ (1 ÷ 1.05^8 + 2 ÷ 1.05^6 + 1 ÷ 1.05^4) = 160000 × 1.05^4 ÷ (1 + 2 × 1.05^2 + 1.05^4), which when he comes of age will amount to 160000 × 1.05^8 ÷ $(1 + 1.05^2)^2$, which divided by amount paid for his share must equal amount of \$1 for the given time and required rate, *i.e.* = (1 + interest for 1 year)^4. The fourth root of the above quotient = $1.05^2 \times 20 \div 1.45 \times 13 = \frac{441}{377} = 1.16\frac{368}{377}$. ∴ rate % = $16\frac{368}{377}$. In the question \$16000 should be \$160000. (5.) \$4282.80. (6.) 22.9175; 13.7505. (7.) 35 + B + C = 37. (8.) See Appendix Canadian Edition of Hamblin Smith's Arithmetic. \$7065.04. (9.) Let x = length; then since area is 40 rods, $\frac{40}{x}$ = breadth. $x + \frac{40}{x}$ = min. = p., from which r is found to be $2\sqrt{10}$, and breadth $2\sqrt{10}$.

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(2.) The error in each case diminishes the value of the fraction; hence the debt less 4s. 7d. is to the debt less 2s. 6d. as 99 is to 100. The debt is therefore £10 10s. 10d., and the decimal is .25̇. (3.) $\frac{5915\times(\text{price}+1)}{5746}+\frac{1}{2}=\frac{5984\times\text{price}}{5746}$ $=84\frac{1}{2}=$ price. $6800 stock bought and sold. (4.) 24 lbs. of gold + 24 lbs. of silver are worth $1293.75; 24 lbs. of gold are worth $1236.00; 24 lbs. of silver are worth $57.75; 1 lb. of silver is worth $2.40\frac{5}{8}$. If the mixture were all gold it would be worth $1236.00. The silver in it reduces its value $386.25; 1 lb. of silver would reduce its value $49.09\frac{3}{8}$; hence there must be $386.25 ÷ $49.09\frac{3}{8}=7\frac{1}{1}\frac{3}{5}\frac{6}{7}\frac{3}{1}$ lbs. of silver. 24 lbs. gold + 24 lbs. silver = $1293.75; 24 gold = $1236 ∴ 24 silver = $57.75; and 1 silver = $2.40\frac{5}{8}$, price per lb. (5.) The present value of the mortgage is the present worth of $1232, $1184, $1136, $1088, &c.; or $1140.74 + $1015.089 + $901.793 + $799.712 + $707.806, &c. = $6649.377. (6.) The ratio of the time required by one train to travel any distance to that required by the other to travel the same distance is constant, hence $\frac{\text{Ans. in min.}}{37\frac{1}{2}\text{ min.}}=\frac{150\text{ min.}}{\text{Ans. in min.}}$ where ans. denotes the number of min. they were travelling before 9 o'clock; hence ans. $=\sqrt{37\frac{1}{2}\times 150}=75$. The trains started 45 minutes past seven. (7.) The borrower has the use of $573 for 3 months and $535 for 9 months, and he pays $95 for the use of these sums at the end of the year. $573 for 3 months = $1719 for one month; $535 for 9 months = $4815 for one month; $1719 + $4815 for one month $=\frac{6}{1}\frac{5}{2}\frac{3}{4}$ for one year; hence rate per cent. per annum is $17\frac{487}{1089}$, Ans. (8.) True discount on $1 = $5\frac{35}{53}$c.; bank discount on $1 = 6c. ∴ banker's gain is $\frac{18}{53}$ on $1 ∵ 28.44 $\div\frac{18}{53}=$ $8374 face of note; $8374 $\times\frac{6}{100}=$ $502.44 bank

discount; \$8374—\$502.44 = \$7871.56; then $\frac{7871.56 \times 100}{125 \times 1264}$ = \$4.98$\frac{1}{5}$ price per yard. (9.) A's \$975.61 nearly; B's \$1050. Rate per cent. is $2\frac{1}{2}$. (10.) $\frac{16}{15}$ ($\frac{16}{15}$ pay + pay) = \$2040; pay = $925\frac{25}{62}$.

XXIX.—Page 278.

(1.) \$54. (2.) $89\frac{7}{8}$. (3.) $66\frac{1}{8}$ (4.) 105 days. (5.) \$4973.314+. (6.) \$10. (7.) 224.701 days. (8.) 29 days, 12 hours, 44 minutes, 2 seconds. (9.) 25.35 days. NOTE.—The number of apparent rotations of the sun in a year will be $\frac{365.256}{27.25}$ or 13.4, but as the earth makes one revolution around the sun in a year, therefore the sun must make 14.4 real rotations in a year, and consequently the time of one real rotation is $\frac{365.256}{14.4}$ or 25.35 days. (10.) 27.2 lbs. NOTE.—First find what a pound of terrestrial matter would weigh at the distance of 426292 miles from the earth's centre. This is found as follows: $426292^2 : 3960^2 : 1 : (\frac{3960}{426292})^2$; then $(\frac{3960}{426292})^2 \times 314760 = 27.2$ The work is most expeditiously performed with the aid of logarithms.

XXX.—Page 280.

(1.) Rent=\$960, rate=\$72, acres=120. (2.) A, 15 miles; B, 10 miles; distance=150 miles. (3.) 11 o'clock. (4.) By indirect route=\$4000—agent's commission at Cuba=\$4000—20=3980; premium at 4% =153.08, ∴ amount of bill on N.Y.=\$3826.92. Again, after agent's commission in N.Y. we have \$3807.79, ∴ 3807.79 × 5.30=20181.287 francs. Direct route=\$4000 —20=3980=(@ 5 francs) 19900 francs. Premium at 1% = 19900—197.03 = 19702.97 = amount of bill on Paris, ∴ 20181.287—19702.97 = 478.317 gain by cir. route. (5.) B's stock=\$15000, C's time=7 months.

(6.) (Question should read $\frac{1}{5}$ A, B, D, $\frac{1}{6}$ A, B, C = 137 respectively.) It is evident that A's + $\frac{1}{3}$ of A,B,C,D—$\frac{1}{3}$ A's = 137, $\therefore$ $\frac{2}{3}$ A's = 137—$\frac{1}{3}$ of all, $\therefore$ A's = $\frac{3}{2}$ of 137—$\frac{1}{2}$ of all, also B's = $\frac{4}{3}$ of 137—$\frac{1}{3}$ of all, also C's = $\frac{5}{4}$ of 137—$\frac{1}{4}$ of all, also D's = $\frac{6}{5}$ of 137—$\frac{1}{5}$ of all, $\therefore$ $(\frac{3}{2}+\frac{4}{3}+\frac{5}{4}+\frac{6}{5})$ of 137—$(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5})$ of all = sum of all, $\therefore$ $(1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5})$ of all = $(\frac{3}{2}+\frac{4}{3}+\frac{5}{4}+\frac{6}{5})$ of 137, $\therefore$ sum of all = \$317. This value substituted gives A = 47, B = 77, C = 92, D = 101. (7.) The series formed by body falling = 100, 50, 25.... &c. Sum = 200. The series formed by body rising = 50, 25, $12\frac{1}{2}$, $6\frac{1}{4}$, &c. Sum = 100. Total distance = 300 feet. The time required for first series = $\left(\frac{100}{16\frac{1}{12}}\right)^{\frac{1}{2}}$, $\left(\frac{50}{16\frac{1}{12}}\right)^{\frac{1}{2}}$, $\left(\frac{25}{16\frac{1}{12}}\right)^{\frac{1}{2}}$ &c., &c., to infinity. This is a G. series first term, $10\left(\frac{12}{193}\right)^{\frac{1}{2}}$ ratio = $\frac{1}{2}$, $1/2$, &c. $\therefore$ sum = $\frac{10\sqrt{\frac{12}{193}}}{1-\frac{1}{2}\sqrt{2}}$. Second series = $\frac{\sqrt{50}\times\sqrt{\frac{12}{193}}}{1-\frac{1}{2}\sqrt{2}}$. These series added give $\frac{(10+\sqrt{50})\sqrt{\frac{12}{193}}}{1-\frac{1}{2}\sqrt{2}}$ = 14.5 + seconds. (8.) Consider first two partners; the capital C_1 for time t_1 and C_2 for time t_2; compare their shares A_1 and A_2 with the shares of a fictitious partner A_3 having capital = C_1 for time = t_2, we have $A_1 : A_3 :: t_1 : t_2$, and $A_3 : A_2 :: C_1 : C_2$, $\therefore$ multiplying we have $A_1 A_3 : A_3 A_2 : C_1 t_1 : C_2 t_2$, or divide first and second by $A_3 = A_1 : A_2 : C_1 t_1 : C_2 t_2$, which was to be proved. (9.) Last payment = \$28, deduct interest = \$$26\frac{2}{3}$ $\therefore$ debt = $26\frac{2}{3}\times 5 = \$133\frac{1}{3}$; first instalment in 73 days = \$$26.66\frac{2}{3}$ + interest on \$$133\frac{1}{3}$ for 73 days = \$28; second instalment in 146 days = \$$26.66\frac{2}{3}$ + interest on \$$106\frac{2}{3}$ for 146 days = \$28.80; similarly third instalment = \$$29.06\frac{2}{3}$; fourth = \$28.80; 5th = \$28. (10.) Let A, B, C, D be centres of the inscribed circs. and circum. do. respectively; G, F, N, points of contact by circum. circ. O F, O H, O G = 168

feet each. Let 6x, 7x, 8x=radii; then A C=15x, B C =13x, A B=14x; then in triangle A C B (where C D is perpendicular to A B). AB : A C + B C :: A C—B C : A D—B D, &c., &c., &c.; hence A D=9x, B D=5x, C D =12x, &c., &c., &c., $\therefore$ $(168-7x)^2 = (12-48\sqrt{12-x})^2 + (x+24)^2$, $\therefore$ x=11. Radii=66, 77, 88 feet.

XXXI.—Page 282.

(1.) The remaining figures may be found by subtracting in order each of those already found from 9. (2.) The radix is 6, hence $\frac{1}{35}$ must give a pure repetend. Reduce $\frac{1}{m}$ to a decimal; it cannot give more than m − 1 places; divide this by m and it will be evident that m − 1 places may occur m − 1 times, but no more. (4.) The increase in the number of teachers is $23\frac{21}{73}\%$ *more*, and that of the pupils $\frac{70}{273}\%$ *less* than the average increase; clearing this ratio of fractions we find each teacher had 90 pupils in 1876; then $(\frac{4}{3}T - 10)\ 81 = \frac{11}{10}$ of 90T or T=90. $33\frac{1}{3}\%$ of 90=30 new teachers engaged. (5.) $(1.4641)^{\frac{1}{4}}=1.1$. He gives $\frac{1}{11}$ of 16 oz. for a lb.; his legitimate gain is $(1.1)^2=1.21=21\%$. (6.) The total income with its int. is $100(1.06)^{\frac{39}{4}} + 110(1.06)^{\frac{38}{4}} + 120(1.06)^{\frac{37}{4}} \times \ldots + 480(1.06)^{\frac{1}{4}} + 490 = \frac{100(1.06)^{10} - 490}{(106)^{\frac{1}{4}} - 1} + 10\left\{\frac{(1.06)^{10} - (1.06)^{\frac{1}{4}}}{\{(1.06)^{\frac{1}{4}} - 1\}^2}\right\} = \$14858.35$ Total expense with interest: $75(1.06)^{\frac{40}{4}} + 75(1.05)(1.06)^{\frac{39}{4}} + 75(1.05)^2(1.06)^{\frac{38}{4}} + \ldots . 75(1.05)^{39}(1.06)^{\frac{1}{4}} = 75(1.06)^{\frac{1}{4}}\left\{\frac{(1.05^{40} - (1.06)^{10}}{1.05 - (1.06)^{\frac{1}{4}}}\right\} = \$11307.90$. His expenses increase in G. P., while his income increases in A. P. (7.) At the end of n years he will be worth $12000(\frac{5}{4})^n - 1000\{(\frac{5}{4})^{n-1} + (\frac{5}{4})^{n-2}(\frac{4}{3}) + \ldots . (\frac{4}{3})^{n-1}\} = 12000\{2(\frac{5}{4})^n - (\frac{4}{3})^n\}$. This will be zero when $2(\frac{5}{4})^n = (\frac{4}{3})^n$, or $n = \frac{\log. 2}{2\log. 4 - \log. 5 - \log. 3} = 10.74$. He had better close when

$2(\frac{5}{4})^n - (\frac{4}{3})^n$ is a maximum, *i.e.* when $2 \times \frac{1}{4}(\frac{5}{4})^n = \frac{1}{3} \times (\frac{4}{3})^n$, or $n = \frac{\log. 3 - \log. 2}{2 \log. 4 - \log. 5 - \log. 3} = 6.28$. For n substitute 6.28, and the amount of his property is easily found by using a table of logarithms. (8.) $1\frac{1}{12}$ miles per hour. (9.) The sum of the areas is the area of the triangle. Euclid vi. 31. (10.) Apply Euclid ii. 12.

XXXII.—Page 285.

(1.) (1) By comparing the work done by A and C in 1 day with that done by A and B in 1 day, we find that C does as much as B + $\frac{1}{12}$ of the work; and substituting this value of C in what B and C do in 1 day, we find what B does in 1 day, and in $2\frac{2}{4}\frac{6}{7}$ days he will do $2\frac{2}{4}\frac{6}{7}$ times as much as in 1 day, and be entitled to that fraction of the whole pay. (2) Find what fraction of the whole pay B *might* have obtained; then the former fraction minus the latter = \$2; from this the whole pay or 1 may be obtained. (2.) The amount to be received equals the entire outlay + $1\frac{4}{8}\frac{0}{6}\frac{7}{3}\%$ of it. In order to find the face of note described, divide the amount to be received by the P.W. of \$1 for the given time at the given rate, allowing bank discount. The amount to be invested may be found by dividing the sum of money sent by \$1 + commission on \$1.

(3.) Let A's stock be 1, and time in trade 48 months,
then B's " will be $\frac{1}{7}$, " " 32 "
and C's " " $\frac{2}{21}$, " " 30 "

The mortgage may be treated as an annuity. P. W. $(1.05)^{10} = \$9700\ \{\frac{(1.05)^{10}-1}{.05}\}$; the P. W. of which would be shared by A, B, and C in a similar manner to that in which the gains of any partnership would be shared by the partners composing it. (4.) Allowing

the merchant's original capital to be 1, we have thus:—$\{1 + 1(\$1 + \frac{r}{100}) + 1(\$1 + \frac{r}{100})^2 + (\$1 + \frac{r}{100})^3\} = \$4374.616$; r, the rate % may easily be determined from data given in the question, if the following principle be remembered: "The discount *off* a certain sum for a given time equals the interest *on* the P.W. of same sum." The rate % here will be found to be 6. (5.) Let 1 be the cost price per lb. of dearer tea; then, if he cleared $\frac{2}{5}$ of the cost price by marking at \$1.54, \$1.54 must equal $1 + \frac{2}{5}$ of cost price, or \$1.10=1, cost price of dearer tea. (6.) Since he has to pay $\frac{1}{2}\%$ commission, the stock is only worth 104 to him; ∴ for every £100 stock or £104 money he gets £4 income, or $\$(\frac{4}{1} \times \frac{4}{9} \times \frac{100}{100})$ for every $\$(104 \times \frac{4}{9} \times \frac{100}{100\frac{1}{2}})$, the agent getting $\frac{1}{2}\%$ commission for transferring. Then, if he can afford to pay $\$(104 \times \frac{4}{9} \times \frac{100}{100\frac{1}{2}})$ in order to get $\$(\frac{4}{1} \times \frac{4}{9} \times \frac{100}{100})$, can he afford to pay more or less in order to get \$6? And, deducting $\frac{1}{2}\%$ commission from this result gives the amount which he can afford to pay for every \$100 stock in order that no change may occur in his income. (7.) Let the distance rowed be 1; the difference between the distance rowed *down* and the distance rowed *up* in 1 hour = rate of stream per hour, and from this the whole distance, or 1, will be found to be 2 miles according to watch time. But the watch gains 2′ on every 24 hours; having found, then, the correct time which it takes him to row *down* and *up*, by a similar analysis to the above, the whole distance, or 1, may be determined, and the difference between the two results will be the required answer. (8.) Time $= \frac{\text{log. } 3}{\text{log. } 6 - \text{log. } 5} =$ &c. (9.) 100 yards @ 10 cents = \$10; 80 yards at $7\frac{1}{2}$ cents = \$6, \$16. Let 1 be the cash price of the 100 yards, then $\frac{3}{5}$ of 1 will be the cash price of the 80 yards. From data given find value of 1,

or the cash price of the 100 yards, and also the cash price of the 80 yards. The sum of these two will be found to be \$15 .·. discount of \$16 would have been \$1, or $6\frac{1}{4}$ off \$100. (10.) This depends on the principle, "The sum of the squares on the sides equals the sum of the squares on the diagonals of any parallelogram."

XXXIII.—Page 287.

(1.) 1 lb. tea and 3 lbs. sugar cost \$1.20; 1 lb. tea and 3 lbs. sugar cost \$1.40 at advanced price; if the price of each had been advanced 50% they would have cost \$1.80 .·. the 40 cents of a difference arises from the extra increase of 40% on the tea .·. 40% of tea = 40 cents. Price tea = \$1.00, price sugar = $6\frac{2}{3}$ cents. (2.) Commission on \$1 for selling = 3 cents; commission on \$1 for investing = $1\frac{46}{51}$ cents .·. total commission on \$1 = $4\frac{46}{51}$ cents; $\frac{530}{.04\frac{46}{51}}$ = \$10812 value of consignment, .·. $\frac{6}{95}$ (10812—530) = \$649.38$\frac{18}{19}$. (3.) Taking 1 ounce of each defaced ornament gives $\frac{1}{10}$ ounces too much gold in the new ornament, .·. we infer that we have taken too much of the first and too little of the second; but ounce for ounce the first contains $\frac{3}{10}$ ounces more gold than the 2nd, .·. we must take as much less of the first as will make up the $\frac{1}{10}$ ounces, .·. $\frac{1}{10} \div \frac{3}{10} = \frac{1}{3}$ ounces too much of first, .·. $\frac{2}{3}$ ounces first and $1\frac{1}{3}$ ounces second. (4.) $\frac{260}{1.08} + \frac{248}{(1.08)^2} + \frac{236}{(1.08)^3} + \frac{224}{(1.08)^4} + \frac{212}{(1.08)^5}$ = \$949.6353. (5.) If he had passed all he would have gained 26s., .·. 312s. = value of all the coins before reduced; 299s. + reduced coin = what he had when arrested. Total loss neglecting reduced coin = 13s., but by question 4s. $10\frac{1}{2}$d. was gained, .·. reduced coin = 13s. + 4s. $10\frac{1}{2}$d. = 17s. $10\frac{1}{2}$d. .·. 16 sovereigns. 19s. 6d. (6.) $\frac{1200}{1004}$ = ready money B is willing to receive. For every \$1 A puts on his note he

..ould have to pay 2 cents for the use of D's name, and also the bank discount on $1 for 4 months 3 days at 8%, ∴ .02733+.02=.04733=amount taken off for every $1 put on face of note ∴ $.95\frac{1}{2}67 \times \frac{1200}{1.04} = \$1211.17+$. ∴ first way better by 11.17+. (7.) $8\frac{1}{3} + 6\frac{2}{3} = 15$ miles, of distance between Express and Freight when Express is met by Mixed; but Express had $7\frac{1}{2}$ miles start on Freight, ∴ Express has gained $7\frac{1}{2}$ miles on Freight, ∴ 2 o'clock time Express meets mixed, ∴ 1 o'clock. (8.) $5\frac{5}{7}\% + 2\frac{6}{7}\% = 8\frac{4}{7}\% = \frac{3}{35}$, ∴ $1\frac{3}{20}$ of cost $\times \frac{35}{3} = \$496.80$. ∴ $5040, Answer. (9.) Let C B be the horizontal plane, A C spectator, B E pedestal, E D statue. Join A B, A E, A D, and draw A F parallel to C B, meeting B E in F. Angle D A E=E A B ∴ $\frac{AB}{AD} = \frac{5}{8}$ (Euclid vi. 3.) From this we find A B=100 and A E=$30\sqrt{20}$. (10.) Radius of circumscribed circle $= \frac{8 \times 10 \times 12}{4 \text{ area } \Delta}$; radius of inscribed circle $= \frac{2 \text{ area } \Delta}{8+10+12}$; Area Δ $=15\sqrt{7}$, ∴ $\frac{9\sqrt{7}}{7}$.

XXXIV.—Page 299.

(1.) Rent $+\frac{2}{100} \times \frac{80}{100}$ rent $= \frac{127}{125}$ rent $= \$3175$; $3175 \times \frac{125}{127} = \$2500$, taxable income. (2.) $\frac{1}{8}\% \times 100 = \$175$ = price of 100 stock not considering dividend; $\frac{2}{3} \times 7 \times \frac{100}{101} = \$4\frac{2}{3}\frac{3}{8}$ = worth of that part of dividend not due to purchaser; $\$175 + \$4\frac{2}{3}\frac{3}{8} = \$179\frac{3}{3}\frac{3}{8}$ = price of stock two months before dividend is due. (3.) $\frac{500}{(1.07)^8} \left\{ \frac{(1.07)^{10}-1}{.07} \right\} =$ $4020.59, Ans. (4.) Find the time in which the sum of the present values of each payment would amount to the sum of the debts at the given rate. 18.4 months. Ans. (5.) $10\frac{2}{41}\frac{2}{}$ days. (6.) Let t be the required time; then

$(\frac{15}{24})^t=\frac{8}{3}$, whence $t=\frac{3\log.2-\log.3}{2\log.5-3\log.2-\log.3}=24.02$ years. (7.) $\frac{1500}{(1+r)_{15}}\left\{\frac{(1+r)^{15}-1}{r}\right\}$ = present worth of annuity where r = rate; $\frac{1}{(1+r)^{15}}\left\{\frac{1500}{r}\right\}$ = present worth of perpetuity where r = rate; then annuity better than perpetuity when the former is greater than latter, or when log. (1+r) greater than $\frac{\log.2}{15}$, or when r greater than 4.7296%. (8.) $\frac{9}{16}\left\{\frac{496}{1.09}+\frac{464}{(1.09)^2}+\frac{432}{(1.09)^3}\right\}$ = \$665.265. (9.) 8 bushels @ \$1.75, 40 @ \$1.80 and 32 @ \$2. (10.) $100000\times\frac{80}{100}\times\frac{397}{400}\times\frac{401}{400}\times\frac{203}{200}$ = \$80792.47$\frac{3}{4}$; $100000\times\frac{80}{100}\times\frac{199}{200}\times\frac{203}{200}$ = \$80794.

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